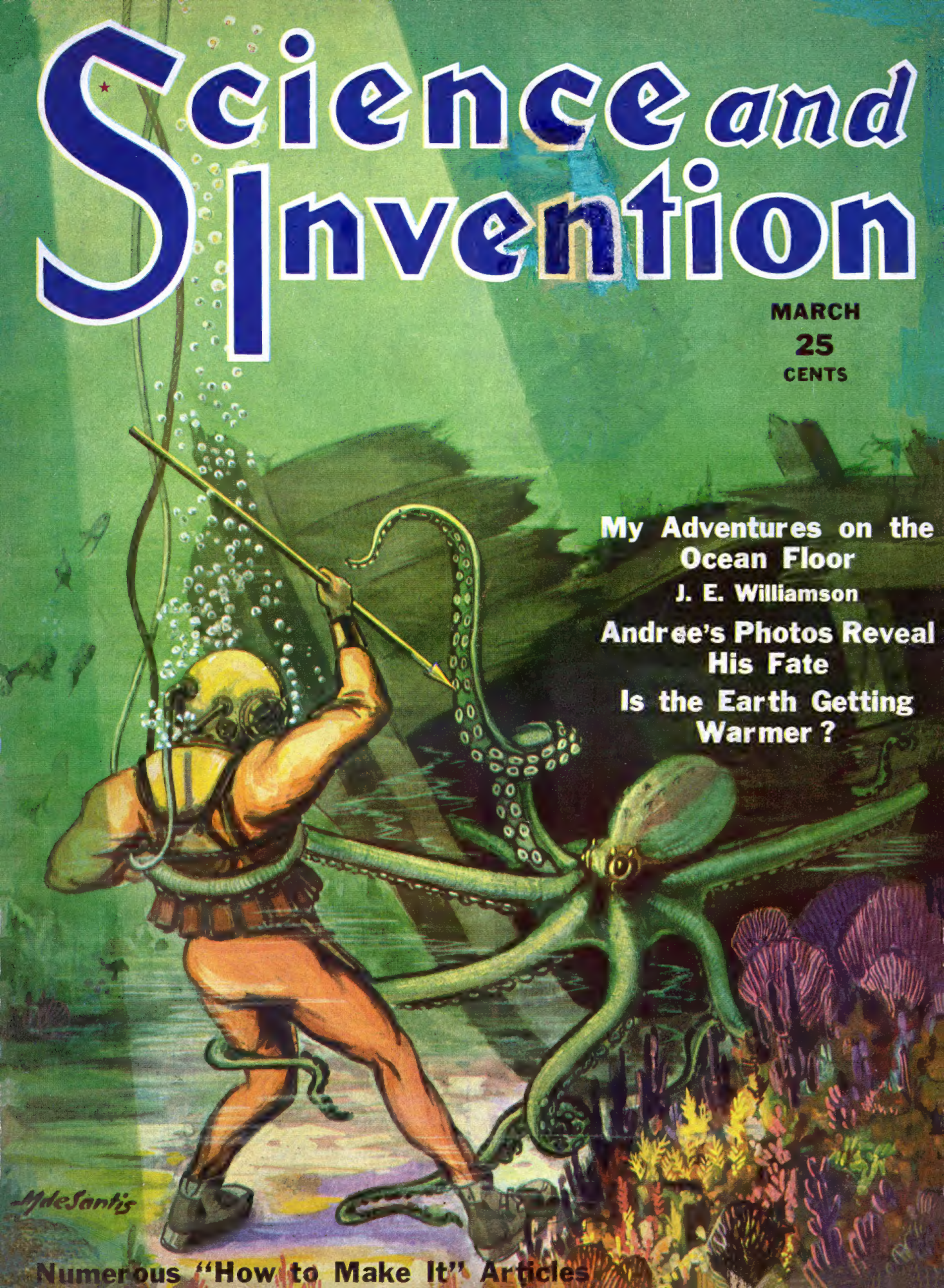
Science and Invention

MARCH
25
CENTS



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When trained by me, I help you get a job without charge. Employers of draftsmen come to me for competent draftsmen at $60 - $70—up to $100 a week straight salary.

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How to get a good job in the Radio Industry

Hundreds of Jobs paying $50, $60, $75, $100 a week are opening in Radio every year.

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I showed these men how to get *Big Pay* jobs like *these*

If you are earning a penny less than $50 a week, send for my book of information on opportunities in Radio. It is free. Radio's amazing growth is making hundreds of fine jobs every year. My book shows you where these jobs are, what they pay, how I can train you at home in your spare time to be a Radio Expert.

Seldom Under $100 a Week

"My earnings in Radio are many times bigger than I ever expected they would be when I enrolled. In November I made $577, December $645, January $465. My earnings seldom fall under $100 a week. I merely mention this to give you some idea of what a Radio man can do who has the training."

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FRED A. NICHOLS,
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My New 8 Outfits of Parts give you extensive Practical Radio Experience

With me you not only get the theory of Radio—you also get practical Radio experience while learning. You can build over 100 circuits—build and experiment with the circuits used in Atwater-Kent, Majestic, Crosley, Eveready, Stewart-Warner, Philco, and many other sets. These experiments include A. C. and screen grid sets, push pull amplification and other late features. When you finish my course you won't need to take "any old job" just to get experience—you will be trained and experienced ready to take your place alongside men who have been in the field for years.

Back view of 5-tube A. C. screen grid tuned Radio frequency set—only one of many circuits you can build with the parts I give without extra charge.

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Hold your job until you are ready for another. No need to leave home. All I ask is part of your spare time. I have doubled and tripled the salaries of hundreds through my practical home-study training. You don't have to be a high school or college graduate. My course is written in easy, simple terms that most anyone can understand.

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My course is up-to-date with Radio's latest uses and improvements. It includes Radio's application to Talking Movies, Television and home Television experiments, Wired Radio, Radio's use in Aviation, in addition to fitting you for many other lines. When you finish you won't be a "one job" man. You will be trained for many jobs.

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I will agree in writing to refund every penny of your tuition if you are not satisfied with my Lesson Texts and Instruction Service when you have finished my course. This agreement is backed by the Pioneer and World's Largest organization devoted entirely to training men and young men for good jobs in the Radio industry, by correspondence.

Find out what Radio offers you Get My Book

This book gives you the facts on Radio's opportunities and the many features and services of N.R.I. training. It gives you 100 letters from actual students who have proved that my methods are successful. Get your copy today. There is no obligation.

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National Radio Institute, Dept. ICS
Washington, D. C.

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Washington, D. C.

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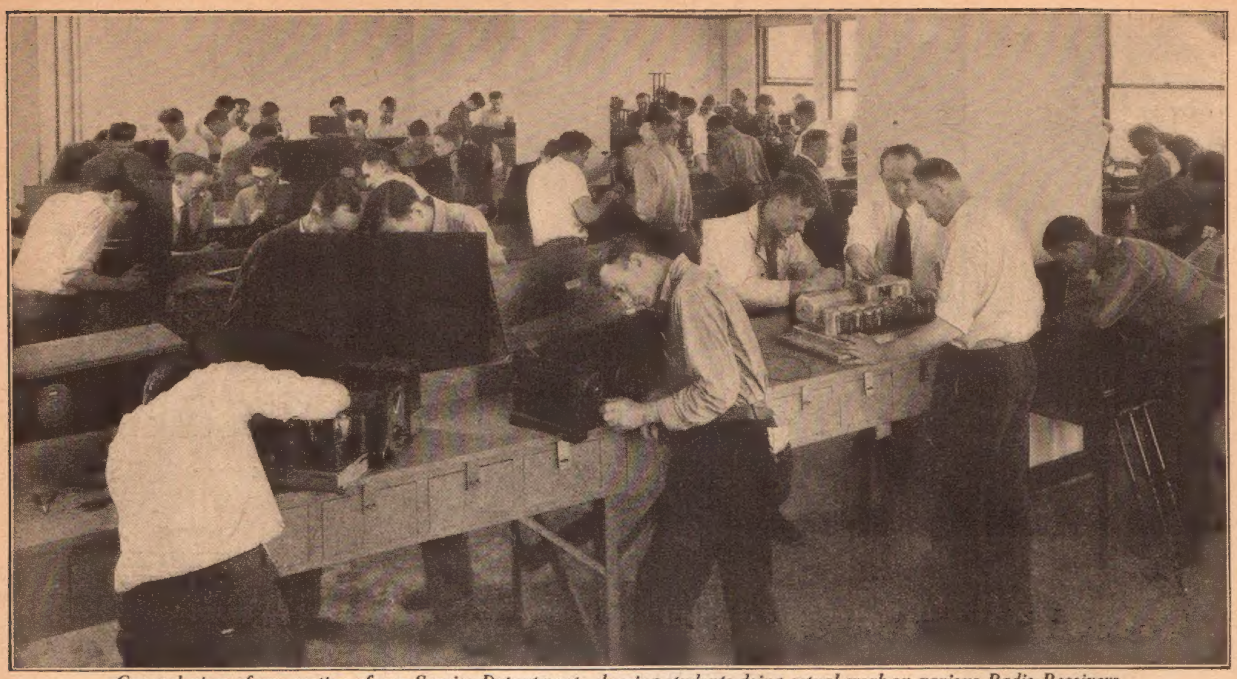

General view of one section of our Service Department, showing students doing actual work on various Radio Receivers

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NOT By BOOKS Or CORRESPONDENCE - By

Don't spend your life slaving away in some dull, hopeless job! Don't be satisfied to work for a mere $20 or $30 a week. Let me show you how to make **real money in Radio**—the fastest-growing, biggest **Money-Making Game on earth!**

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Paying $60, $70 to $200 a Week

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All Practical Work

Coyne is NOT a Correspondence School. We don't attempt to teach you from books or lessons. We train you on the finest outlay of Radio, Television and Sound equipment in any school—on scores of modern Radio Receivers, huge Broadcasting equipment, the very latest Television apparatus, Talking Picture and Sound Reproduction equipment, Code Practice equipment, etc. You don't need advanced education or previous experience. We give you—**right here in the Coyne shops**—all the actual practice and experience you'll need. And because we cut out all useless theory, you graduate as a Practical Radio Expert **in 8 weeks' time.**

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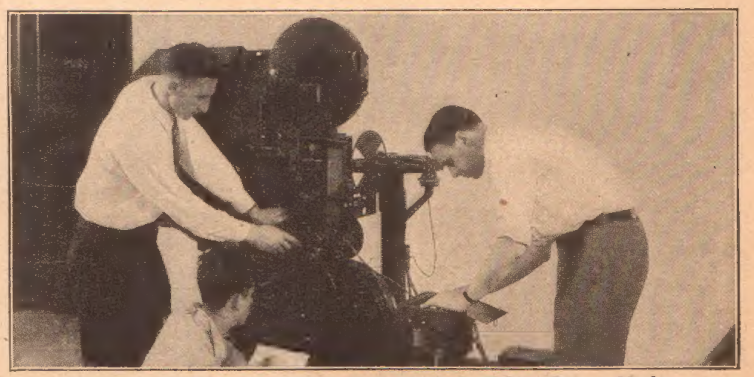
IS ON THE WAY!

And now Television is on the way! Soon there'll be a demand for **Thousands of Television Experts!** The man who learns Television **now**



Instructor explaining principles and operation of a Talking Picture Machine

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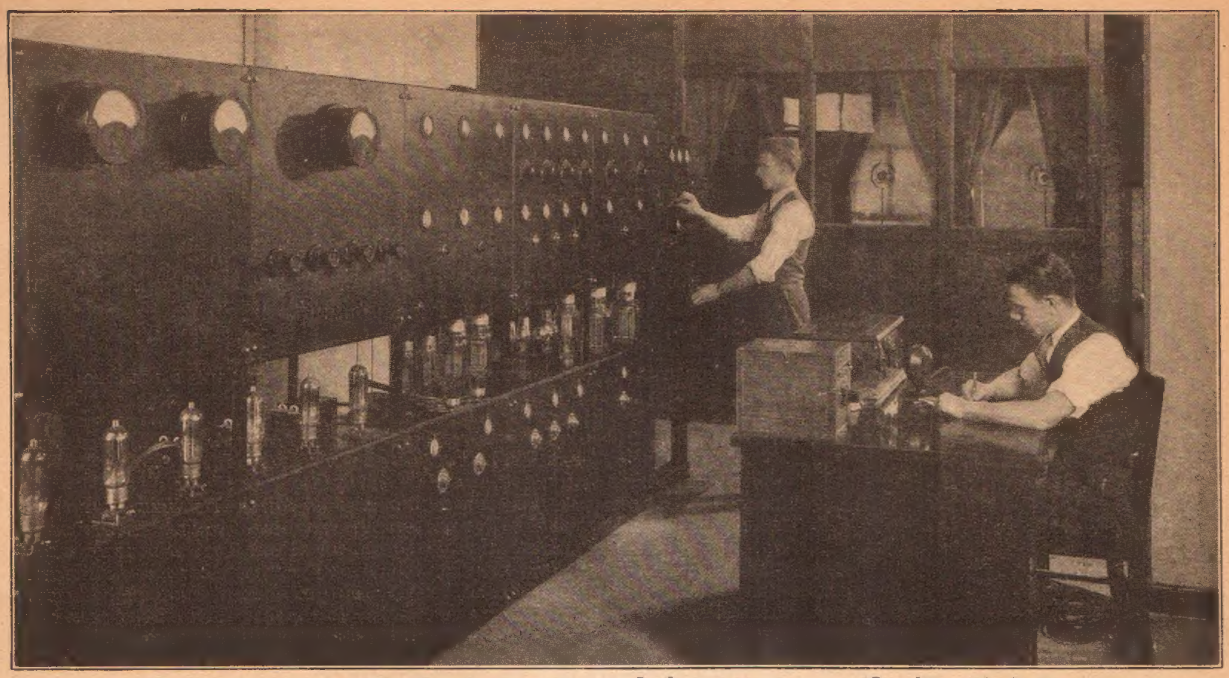

Students operating our modern Broadcasting equipment. In the rear you can see our Sound Proof Studio Room

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Don't worry about a job! **Coyne Training settles the job question for life.** We often have more calls for Coyne Graduates than we can supply. **You Get Free Employment Service For Life.** And don't let lack of money stop you. If you need part-time work while at school to help pay living expenses, we will gladly help you get it. Many of our students pay nearly all of their expenses that way.

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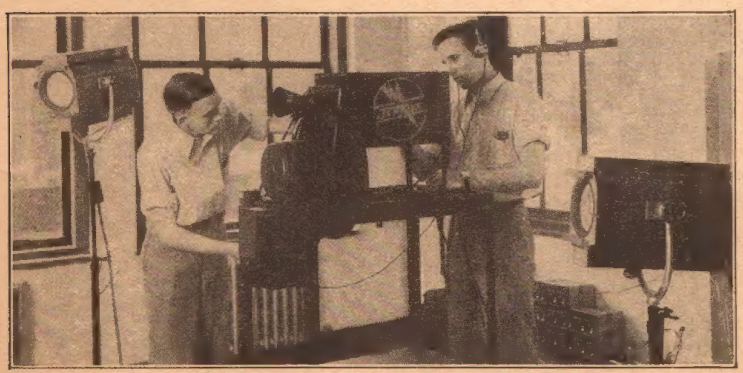

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MARCH
1931

Science and Invention

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No. 11

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an OPPORTUNITY TOO GOOD TO MISS!

Offered by the World's Fastest Growing Business

The great Radio Industry, because of its amazingly rapid growth, is today badly in need of hundreds of "trained" men to fill its more responsible jobs in Radio, Talking Pictures, and Television work.

To qualify for these jobs men must know Radio as they know their A B Cs. They must know the theory as well as the practice, and be able to teach other men some of the things they know.

To such men the great Radio industry offers a wonderful opportunity for steady work at exceptionally good pay, now, and early advancement to still better jobs as a future. It is, in fact, the chance of a life-time for ambitious men.

But first these men must be trained, for no ordinary knowledge of Radio will do.

The Radio Industry, itself, has no time to train these men. It is growing so fast, and changing so fast, that its manufacturers and jobbers have all they can do to keep up with the trend of the times, by improving their methods of manufacture and distribution.

So the training of men for these jobs has become the task of the Radio and Television Institute, of Chicago.

As few men can afford to quit their work and get this Training at some University or Technical School, the Radio and Television Institute has been organized to train such men at home — no matter where they live,—in their spare time, and at a very nominal cost, for these better paying jobs in Radio, Talking Pictures and Television.

The Institute's Course of home-training was planned, written, and is actually supervised by an Advisory Board made up of prominent and highly paid engineers and executives, each of whom is actively connected with some big Radio concern.

This means that your training will be right, because these men, working with big Radio concerns, know exactly what the industry needs in the way of "trained" men, and exactly how you should be trained to meet that need. And this Advisory Board will have complete supervision over your training from the day that you become a student of this Institution.

For this reason, prominent Radio men, everywhere—and our country's largest and most important Radio Trades Associations — are unqualifiedly endorsing this home training, and recommending it to men whom they want to see make good in Radio work.

So, if you are ambitious — if you are making a cent less than $75 a week—investigate.

Find out for yourself all about this amazingly easy Course of home-training, and also all about the wonderful opportunities for "trained" men in this, the world's fastest growing industry. Everything is fully explained in the Radio and Television Institute's "Opportunity" book. Send today for your copy. It's free.

RADIO AND TELEVISION INSTITUTE, Dept. 913 2130 Lawrence Ave., Chicago

Without obligation of any kind please send me a copy of the Radio Opportunity Book. I am interested in your home-training and the opportunities, you say exist in the great field of Radio, for "trained" men.

NAME_____

ADDRESS_____

The SAFETY VALVE

This Department Is Conducted By and For You. Expressions of Opinion or Comments Are Welcome. Please Address Them to Safety Valve Editor in care of this publication.

When a Car Tips

WE have no issue similar to the SCIENCE AND INVENTION here and, although it is a far cry from S. Africa to the U. S. A., we are compelled to turn to your magazine to relieve the excessive pressure on our safety valves. I should greatly appreciate your elucidation of a point in applied mathematics, which recently cropped up in a lawsuit here in connection with a motor accident.

An expert gave evidence in court and stated that when a car was traveling at a fair speed, say 45-50 miles an hour, and at that speed took a turn at right angles, the inner wheels of the car would be off the ground and the outer wheels would resist the tangential force generated. It, somehow, does not seem right to me and I should greatly like you to give me a mathematical explanation of what takes place in such an eventuality.

Also let me add my appreciation of your issue, which I had been reading for a number of years, with interest and benefit.

D. BEHRMAN,
Johannesburg, S. Africa.

(We won't go so far as to say that whenever an automobile traveling at a rate of 45-50 miles an hour makes a right angle turn, the inner wheels would be off the ground. Here it depends on the weight of the car and the position of the center of gravity. However, in view of the fact that the center of gravity is always higher than the point of the tires touching the road, the car will have a tendency to pivot on the outer wheels and will have a tendency to upset. If the road is slippery, instead of upsetting the car may skid. If the road is properly banked the car will not turn over even if light and if its center of gravity is relatively high. Such bankings brings the center of gravity of the car lower with reference to the line about which the car would pivot.—EDITOR.)

Corsica

AS I am a subscriber of SCIENCE AND INVENTION, I noticed in reading the November, 1930, issue, that on page 601 there is an article entitled "Where Drains Run On the Outside of Houses," in the brief descriptive paragraph below the small picture, there is a statement that the island of Corsica now belongs to Italy. To my knowledge the island of Corsica does not belong to Italy, but belongs to France. My reason for being so positive is that I have two brothers-in-law who are Corsicans and who served very faithfully under the French flag during the World War. You are probably aware of the fact that the discussion between France and Italy at the present time is due to the fact that Italy desires to have possession of some of the French possessions among which Corsica is included.

Should it happen that I am not correct in my statement I would greatly appreciate it if you would enlighten me on this subject, as I am greatly interested, and trusting to have an early reply, I am

LEON L. CHABBERT,
Yonkers, New York

(You are correct. Corsica belongs to France. In its physical formation Corsica undoubtedly belongs more to Italy than to France. The flora of the valleys does not differ materially from that of Italy. The vernacular is corrupt Italian. It became French property in the year 1768. *In* 1794 *it came under British protection and obtained the constitutional form of government. Two years later the French again took possession of the island. This island was the birthplace of Napoleon.*—EDITOR.)

Another Glider Enthusiast

I JUST received my November SCIENCE AND INVENTION today and was interested in reading about the Northrup Glider built by Harold Moore and Russell A. Wheelock of St. Johnsbury, Vt., which article appears in the Safety Valve Department of the November issue.

We, Mr. H. A. Wise and myself, too, have built a Northrup Glider, from specifications appearing in SCIENCE AND INVENTION. We also substituted the Gottengen 441 airfoil, also replaced the wooden parts of the fuselage with steel tubing and increased the area of the tail surfaces one-third on account of the slower speed at which this wing will fly.

We finished the job in July, the first glider to be built in Southwestern Oregon, and have made numberless successful flights with it. Neither Mr. Wise nor myself had previously had any training whatever, but had no trouble in handling it from the start.

We are handicapped in not having a suitable hill to launch from, but have gained an altitude of from sixty to seventy feet from level ground using an automobile for a tow. Our ship weighs approximately 180 pounds, has a wing spread of 34 feet and with the Gottengen 441 wing has proven very efficient and will take off at twelve to fifteen miles per hour.

We have organized a Glider Club with about fifteen active members, and OH, BOY! we had the thrill of our lives the first time up.

E. M. KENT,
Marshfield, Oregon.

From Sam Loyd

APPERTAINING to the problem of cutting a square so that resulting formation is apparently larger in square inches than the original from which it was constructed,

here is one which does not discard pieces in the transformation as does the 13 by 11 inch piece recently discussed in the "Safety Valve" department.

Take the accompanying illustration for a pattern and cut any size piece of paper exactly square, then mark off 24 points on each side as microscopically correct as you care to. If the small lines are then continued from border to border, there will be 576 small squares. Now draw a diagonal from the corner A to the second mark near B. Cut on that bias and move the top portion up one space on the incline and snip off the little triangular piece A so as to fill in the top left hand corner. If you will now remeasure the piece, you will find that there are 575 squares instead of 576.

This puzzle which I promulgated in my early youth becomes more mysterious when accurately constructed. The fallacy lies in assuming that the little triangular piece is exactly the same height as one of the little squares. As a matter of fact, the angle at which it is cut gives it an additional 1/23 of the height of the little squares. Consequently, the new figure apparently 25 by 23 is actually 25 1/3 by 23, so its area as before is 576. One did not lose a square inch by merely cutting along the bias.

SAM LOYD,
Brooklyn, N. Y.

An English Enthusiast

A COPY of your SCIENCE AND INVENTION has come to hand and I feel I must congratulate you on such fine work. It represents to my mind a journal that contains modern comprehensive thought explained in a clear concise manner.

W. E. ROBERTS,
London, S. E. 16, England

I ENJOYED the articles in the October issue of SCIENCE AND INVENTION entitled "Wonder What a Soaring Pilot Thinks About," "Deadly Germs to Make You Well," "In the Spotlight of Science," "Metals that Grow" and your regular monthly departments, very much. If your future articles are just as interesting you can be sure of keeping me as a regular reader.

I am glad that you have improved your covers.

What has happened to your artists, W. E. Reinicke, Newberry and R. E. Pattiani? The cover pictures that they have drawn for you were very good. Bring them back. Also have a different colored background each month or have a gold or silver cover.

(*Continued on page* 1041)

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Here's just the book you've been waiting for. "HOW TO MAKE IT—WRINKLES, KINKS, FORMULAS"—the complete all-around guide for almost all kinds of repairing and construction. An aid to every man or boy who has felt the urge to grip good tools and see useful finished articles take shape as the combined result of skillful hands and brain!

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Whether it's repairing or working in metals, concrete, woods, stains, paints, piping, or what have you—this handy book, the work of our expert mechanics and engineers, tells you exactly how by means of simple English, and scores of clear pictures, diagrams and plans.

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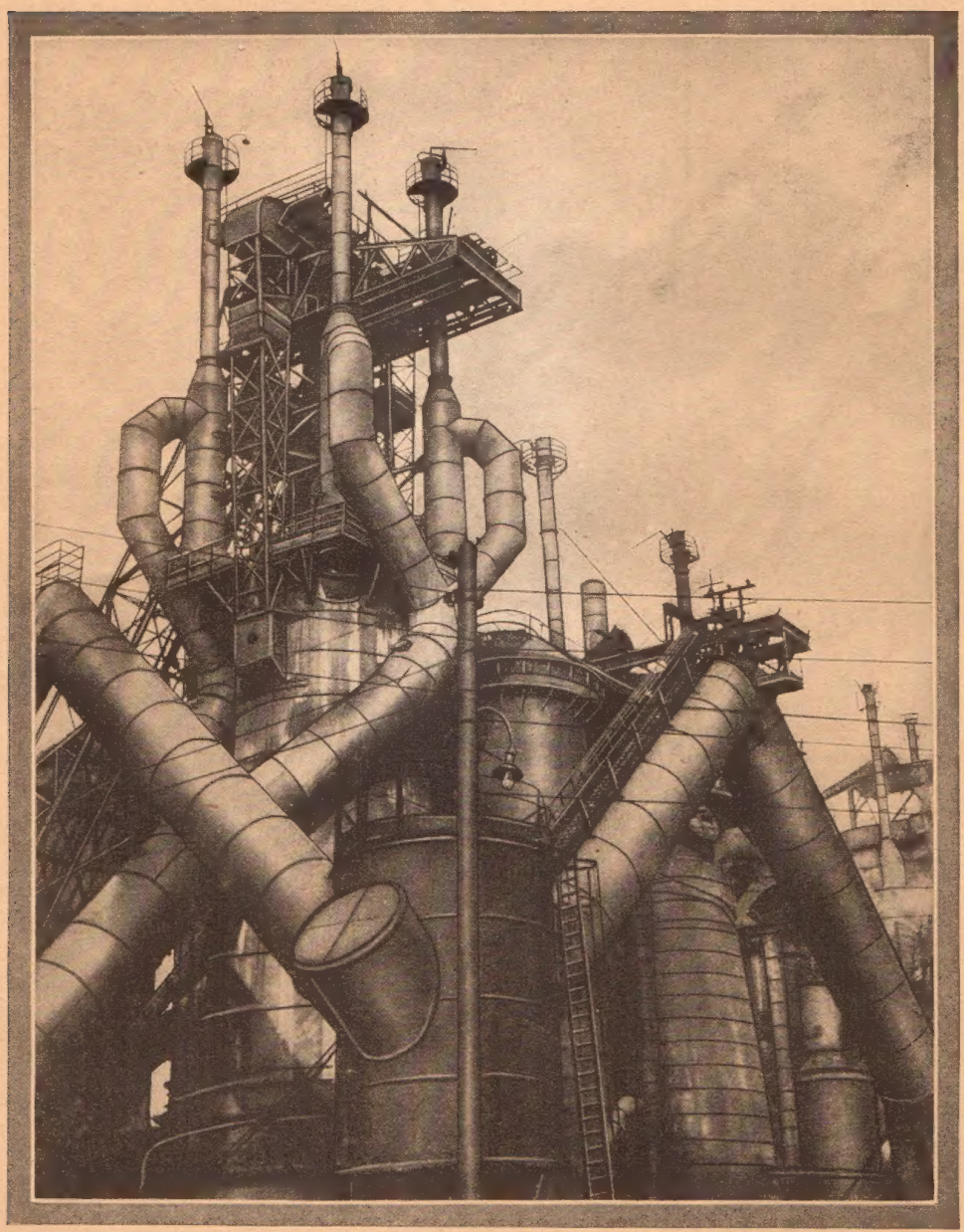

This Fantastic-Looking Picture Is a View of the Blast Furnaces of the Stalin Metal Factory in the Donetz Basin, Where 13,000 Men and Women Are Employed

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A. DINSDALE
Managing Editor

T. O'CONOR SLOANE, Ph.D.
Associate Editor

MARY JACOBS
Feature Editor

DR. DONALD H. MENZEL
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Editorial

Will-o'-the-Wisps of Science

THE possibility of achieving the impossible still interests us because of its powerful fascination. It is no small wonder, then, that even in this day we hear of people still working on the problems which occupied the minds of many ancients for their entire lifetime. Among these problems are, the transmutation of metals (changing baser elements into the more valuable), the development of perpetual motion, the quadrature of the circle and the tri-section of the angle.

It is generally supposed that a large financial reward is offered by the French Academy of Science and the Royal Society of England, for the solution of the two latter problems given in the paragraph above. Such is not the case. There is no such reward.

It is also held that the solving of these two problems would be of incalculable aid to navigation and astronomy. Again the assumption is wrong.

In the year 1775, the Royal Academy of Sciences, of Paris, passed a resolution not to entertain any communication which purported to solve the problems of the quadrature of the circle, the tri-section of an angle or described any machine supposed to be capable of developing perpetual motion.

And yet, science has gone right back to the old days of alchemy and attempted transmutation of mercury into gold by atomic bombardment.

Mathematicians are still "squaring the circle," trying to discover a simple method whereby a square can be constructed which will be exactly equal in area to that of a given circle.

But here is the hitch. It is quite impossible to ascertain the exact area of a circle, even though the value of π (upon which the calculation of the area of a circle is based) has been carried out to the astounding number of 707 decimal places.

Let us suppose that we have a circle of metal as thick as this earth and having a diameter of 185,800,000 miles, (the diameter of the earth's orbit). Calculating the area of this circle, using π to the 707 decimal places, it would be possible for us to produce a metal square so exactly equal in weight that our most delicate of chemical balances would not be able to indicate the difference in weight between the two pieces of metal.

But "circle squarers" still work on.

At last comes a little ray of sunshine for the modern Alchemists and the "squarers of the circle." One of their sister problems has been solved, according to reports made public by Prof. Harry Zager, head of the Mathematics Department of Boston College, who collaborated with George A. Hurd, the originator of a method for tri-secting any arc. Both Mr. Hurd and Prof. Zager are reticent about the exact proof and details of the system, but report that their method "is the only one using the square and angle only."

Both men assert that the method has a broad application in navigation, range finding at sea, and astronomy. How broad this application may be, remains to be seen.

Mr. Hurd is reported to have spent more than ten years on the solution.

We do hope that the ancient problem has been solved once and for all, for its solution will release angle tri-sectors from their labors and allow them to ponder over the other will-o'-the-wisps of science, if science may be said to possess any.—*Editor.*

If it Climbs *this* HILL it will climb anything

GOOD, ordinary gasoline is in the tank, and yet the engine is "knocking" as if it were on one of the steepest hills in the world. It is.

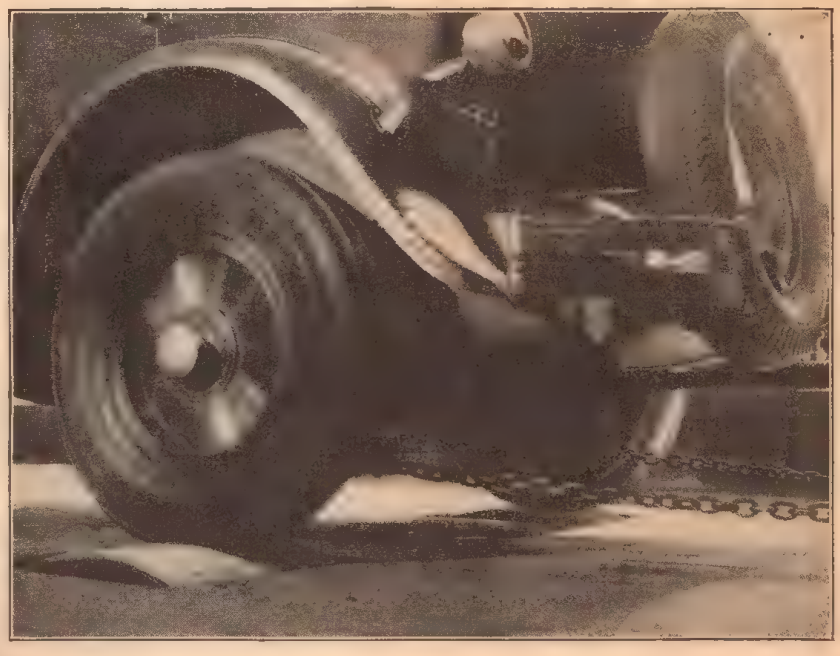
Those rollers under the rear wheels are harder to climb than Pikes Peak. The dynamometer shows their resistance is equal to a 20% grade.

But switch the gas feed from ordinary gasoline to Ethyl Gasoline.

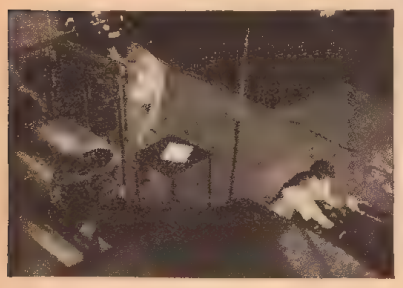
The "knocking" stops, the wheels begin to roll faster, and the driver shifts back to high.

What is the difference? A gallon of good gasoline was used for fuel at first. Another gallon of identical gasoline *plus* a teaspoonful of Ethyl fluid was used for the second test.

These few drops of Ethyl fluid



The mounds under the wheels are braked to tax pulling power more than the steepest hill you'll ever drive.



This isn't a dynamo in the left of the picture; it is a dynamometer which measures the pull on the rollers under the wheels of the car.

The active ingredient used in Ethyl fluid is lead

prevent the uneven explosions of gasoline that cause power-waste, "knock" and over-heating. They *control* combustion so Ethyl Gasoline delivers its power to the pistons with smoothly increasing pressure.

This test does *more* than prove that Ethyl Gasoline prevents "knocking" under strain. It proves that the greater power Ethyl Gasoline gives on any kind of road is not only greater engine power, but greater rear-wheel power.

Try Ethyl Gasoline in your car. See how it increases power, gives you quick get-away and sends you zooming up hills in high. You will find pumps everywhere marked with the Ethyl emblem. Ethyl Gasoline Corporation, Chrysler Building, New York City.

WITH ETHYL BRAND OF ANTI-KNOCK COMPOUNDS — ETHYL GASOLINE CORPORATION NEW YORK U.S.A. — Knocks out that knock

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My Adventures on the Ocean Floor

By J. E. Williamson

The Author of This Article Is the Famous Underwater Explorer and Photographer Who, by Means of the Williamson Tube, Made the First Photographs Ever Taken Under the Sea. In Addition to the Undersea Wonders Revealed by His Scientific Research He Has Produced Such Marvels of Cinematography as "20,000 Leagues Under the Sea"

COME with me under the sea. There in the great silence we can talk as wonders unfold along the ocean floor. Come just as you are, for you are not going down in a diving suit or helmet, a diving bell or any contraption that will get you wet, charge you with pressure, or cut you off from a free supply of the air above. You are going with me down the "hole in the sea" to cruise through the mysteries of the ocean—as comfortably as you would sit in your car and drive leisurely along a country road.

We arrive on location in a place of enchantment near the outer fringe of the West Indies, where Columbus, feeling blindly for land, may have guided his magic fleet over the very waters we rest upon, and now the fairyland of the aquatic world awaits us below.

The depth has been sounded and, section after section, the required length of our submarine tube has been coupled together and lowered away by our crew and all is ready.

You can climb down with me under the sea or be lowered in a seat, but the construction of the tube forms a natural ladder, and to climb down, or up, leaves the action entirely to you. You will climb? Fine! Let's go—down—down we go. This is easy. We can rest awhile here, for we must be about forty feet below. You can see how the water pressure affects the flexible metallic tube. It works in accordeon fashion, adding strength and weight to its structure, and adjusting itself to the pressures of the sea. The bending motion felt near the surface lessens as we descend.

Lulled in the cradle of the deep. Baby Sylvia Williamson flattens her nose against the heavy plate glass window of her father's undersea chamber, as she glimpses the wonders of the sea.

It is quiet here—away from the waves at the surface.

Another forty feet down and now we are in the studio at the bottom of the tube, thirteen fathoms deep. There is room for several more here, so we won't be crowded. Please be seated and rest comfortably. You may smoke if you wish. There! The comforts of home! Now, to start on your journey. I draw the curtains aside so that you may see with your own eyes the mysterious floor of the ocean.

Look! What luck! We have landed right into the heart of an old wreck with only its "dead bones" remaining. I was hoping to locate it, for I passed it here once before and I know it harbors some weird denizens of the sea. Our eyes are becoming accustomed to the pale light now, but I can flash on my lights if they are needed. Did you see that giant moray loop out of the rotted ribs of the wreck? His green, snake-like body

must have been twelve feet long. He is a specie of conger eel equipped with poisonous teeth capable of shearing off a diver's arm or leg.

I can never forget the encounter between one of my divers and an octopus in an old wreck like this. To see a man caught in the grasp of even one tentacle of the eight-armed monster having a possible reach of thirty feet was a hair-raising thrill, and a desperate struggle, with slashing blows of the diver's knife, was needed to sever the hold of this terrible beast of the deep.

A fair diver, photographed from within the undersea chamber, claws her way round a huge brain coral as she investigates the prolific vegetable growth on the ocean floor.

See this huge shark glide up! Seems like he is coming right in—driving his grey torpedo-like body toward us. If he doesn't change his course—Good! Instinct to dodge saved our thick glass window a nasty shock, for he turned just a few inches away from it. However, you were quite safe, for I held the emergency cut-off from the window and was prepared for any accident.

Once I sat up close to that big five foot window studying the movements of a pack of blood-thirsty sharks. I was so fascinated with the weird scene, that I did not realize the feast I represented in the window as the sharks came right at me head on. I was rubbing noses with them while hunger blotches on their rough bodies showed that their killing urge was on, and my fragile partition of glass was the only barrier that was keeping us apart.

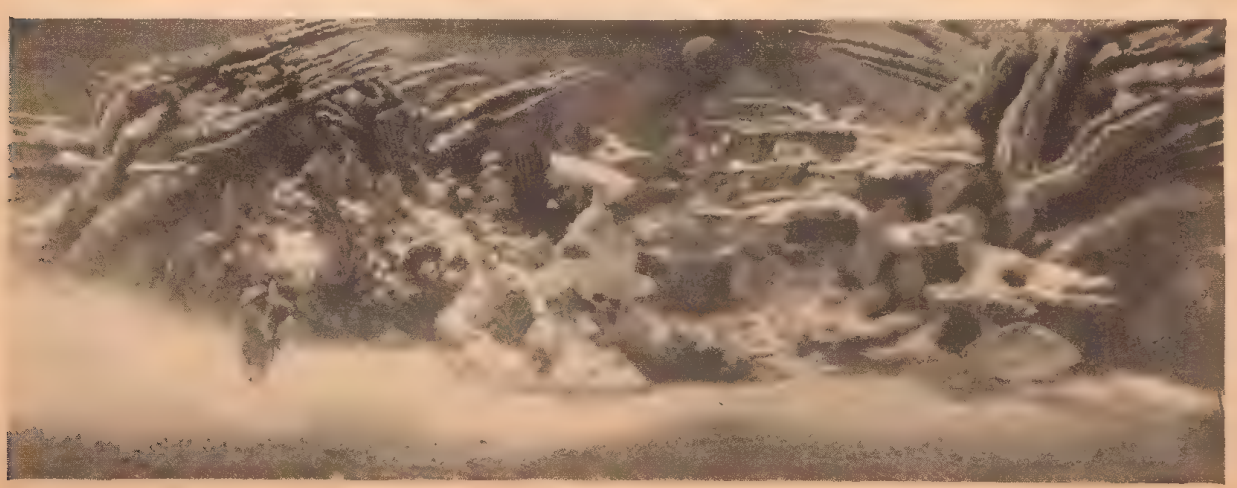
See that tiger shark about to pick up a big muttonfish head our funny colored cook must have thrown overboard from the galley above. The shark glides down to the bait, slides his gaping mouth up to it and takes it in. He did not turn over to bite. Nor does any shark have to turn over to bite. I think the popular idea that a shark has to turn over to bite comes from the roll to the side that exposes his white belly when a shark makes a porpoise movement at the surface, so that he can look around up there. You see, he has a broad flat head and the eyes are wide apart and on the extreme side of the head. This leads him to push one eye up and out for a survey, much as a submarine uses a periscope. But don't forget, a shark can bite from any position.

And is he a man eater? I say "yes." I treat them all as man-eaters. While one or two species lack the bristling rows of teeth that most of them carry, I distrust them all, for I know from many years of experience with them that when they have once had a taste of blood or flesh, they will attack like a mad dog, and one cannot tell when the killing mood may seize them. I know of a number of actual cases where a shark has attacked a man, so I cannot be lulled into a feeling of security by stories that they are not man-eaters. I know also that they are scavengers of the sea. They eat anything when hungry and they are always hungry.

A man can successfully combat a shark in its native element. It has been done and it is possible for a strong swimmer to outmanoeuver the shark under water and get into position by grasping the stiff pectoral pin and swinging in along the underside of the shark to strike up into the vital organs of the slow turning beast. However, the element of luck must favor the man in the get-away back to the surface and air, for the time limit of the encounter is all in favor of the shark, to say nothing of its other natural advantages.

Wonderfully clear are these Bahaman waters. You can see through a distance of two or three hundred feet here, the water is so transparent. Up on the shallower white banks I have seen objects four hundred feet away—sometimes even more. What a weird panorama unfolds as we drift along through the length of this rotted, shell - incrusted hulk. Lazying fish bank up motionless in the shadows. Nothing seems so lifeless as the sunken wrecks of ships. On the surface, in their charmed days of service they seem to live. The throbbing of the engines, their vibrating structures, makes them seem like living things. And here lie the remains of one of those "Queens of the Sea" shrouded in the still, quiet depths.

But we must watch out! The high stern looms up right in our path. That shark turned away and saved our big window, but a crash here would be serious. Don't rise. We are all right. I telephone a signal—"On deck! Take up the chamber twelve feet—All right! Hold it! Lower away some. Hold steady!" Easy to handle is this "portable hole in the sea." I sit here with some gauges to watch and controls to handle while always in close touch by telephone with my crew. I am the pilot, only the usual plan of piloting is inverted. On the bridge of a ship the captain or pilot signals below. I signal up to the surface, giving the course for our surface vessel to move along, carrying the "hole in the sea" and us with it, drawing up our studio or lowering



it down, and all such movements to meet the required depths are accomplished within the construction of the folding walls of the tube. You see, the whole invention broadly consists of three component parts—a surface floating vessel, a terminal work chamber, and the flexible connecting tube. This basic idea in marine construction, invented by my father, I have applied and adapted to my work of undersea photography, designing the special work chamber and my undersea lighting system for the submarine photographic work.

Our wreck is far behind us now and I am drawing up our chamber gradually as we approach a ledge, or "mesa" as you call it in the western hills. A sea of light seems to flow over the edge of it and down the white sand incline, in effect like a waterfall. Look up! Hold! I will work a control and bend the tube around so that you may see overhead—The ceiling of the sea! There is a sight that few have beheld. Millions of light beams flashing through the rippling cups of the waves at the surface, creating a rain of light, and as the shafts flash down to the sea bed, they weave a carpet of soft loops into a tangle of pattern to dance and flow on the sea floor.

Now we are over the ledge and a straight-away course is open for easy sailing. A white coral sand prairie rolling like billows—a sand that is part coral but sown with the impalpable dust of shells.

Do you know, there are great areas of quicksand under the sea, and in developing the drama of one of my photoplays I conceived the idea of having one of my characters, as he walked along the sea floor, caught and drawn down into the quicksands. Another diver, equipped with self-contained diving-suit having no connection with the surface like the trapped man, was to arrive on the scene and effect the rescue at the last moment.

To make the scene real and convincing I chose a location on the very edge of the quicksand in a desolate region on the sea floor. The plan of rescue was unique. One diver could not follow the other into the quicksand, so the rescuer was to endeavor to first sweep a chain around the sinking man, then, by drawing the chain and straightening it out it would come within reach of the victim. It was a ticklish job, but with skillful men in the chemical suits I felt it was worth the risk. Finally all was ready. I called for the cameras to grind and, sitting below here, I felt the terrible menace as the advancing diver began to sink into the gripping ooze.

We had been running short of the chemical known as Oxylithe, carried in the divers' containers to revive and purify their air, and the divers in my scene were forced to use old charges, a dangerous practice, for when the one hour of usefulness of the chemical charge is up, the foul gas coming from it suddenly intoxicates a diver so that, before he realizes it he is a drunken maniac.

I was due for a terrifying experience for, unfolding before me and almost beyond my control I was witnessing intense, real tragedy and, strange to say, not without a humorous side, for the rescuing diver after cleverly placing the chain by walking as far as he could around the area of the doomed man suddenly stopped, sat down hugging his knees as one watching a show and seemed

Trapped in the quicksands! An incident, described in the text, where a diver had to be sent out to rescue another who was being rapidly engulfed in treacherous quicksands.

Drunk on the ocean floor! Another exciting incident, also described in the text, where a diver, wearing a self-contained diving suit, became intoxicated because the chemicals supplying the necessary oxygen became exhausted and therefore poisonous. Below—This diver among the fronds of palmate coral on the sea bottom provides an interesting contrast in size. Photographed from the Williamson tube.

to be enjoying the exit of the man he had come to rescue. The fellow sitting there was strangely intoxicated—drunk on the ocean floor, and only the fact that I held other divers and native swimmers in readiness for the unforeseen accident often occurring in my peculiar work, our trapped man might have disappeared forever, but as it worked out, the "drunk" was harder to rescue than the almost victim of the quicksands.

I have often left the security of the tube and my comfortable seat here to go out into the open, undersea, and

Right—A fight to the finish between a diver, armed only with a knife, and a shark. Below—So strong is the undertow in some places on the sea bottom that divers have to lean far over to combat it. This picture contrasts the two forms of diving suit, one supplied with air from the surface, and the other self-contained.

carry out some details myself in order to avoid the necessity for giving elaborate instructions to some diver who might or might not carry them out exactly as I wanted.

It is a dream-like sensation that comes to one down in a diving suit, and while the equipment you wear may contain one hundred pounds of lead you seem as light as a feather and have to lean at a sharp angle to withstand the undertow and the currents of the sea.

One day I sat below seas in my camera-chamber directing the scenes of a film called "Girl of the Sea." Outside in the pressure, a helmeted diver struggled along the sloping deck of a wrecked ship to the door of a cabin which swung open before him, and there on the floor in a flood of light lay a human skeleton with a knife buried deep in its back, a bony hand disclosing an odd-looking ring. The story hinged on the recovery of this ring and the knife. Deft handling of the scene was needed, and I suddenly decided to go down and do the close-ups myself. So, donning an old diving suit, long unused, I descended and quickly changed places with the diver who left for the surface.

Only the throb of my air-pump broke the death-like stillness. Falling to my knees in this eerie setting, I reached for the knife, as a green moray wormed its snake-like form through the legs of the skeleton, arousing my creepy hate for all manner of snakes and their kind. Moving closer I lifted the knife and turned to the bones of the fingers to remove the ring. Then something happened! Inside the copper helmet of my diving suit I felt something creeping, crawling through my hair, down my forehead and over my left eye to my nose, where I could see—a scorpion. What should I do? Dash my face against the inside of the helmet, try to kill the spidery creature, or let it crawl around on me and take a chance?

That was a good time to keep cool. I played out the scene regardless of the poisonous visitor parading around my head, and as luck would have it, I was not stung.

Hello! A call from on deck. The crew signal to say that a squall is coming. The cooling hand of nature over the face of the tropic sea! Don't be alarmed in the least. I've witnessed many storms from this very window under the sea. It's a great sight to look up underneath the surface when a heavy rain is on. Let's bend the tube around. We can now look up. Waves are splashing above, but on the under side they are undulating smoothly with no broken crests. The sun is still shining and the silver rain of light comes down to us like fireworks. Suddenly the clouds shut out the sun and the heavy raindrops start to pepper the sea, penetrating for several inches, according to their size. Looks like millions of lead pencils being shot into the sea and pulled back again. It is quite dark now. Flash! There goes the lightning, and close follows the muffled roll of thunder. Down go the waves as the rain beats them smooth.

I was fooled by a storm like this during my honeymoon under the sea. It started like an ordinary one but developed into a hurricane. I was sitting with my little bride in a clustered reef location with multitudes of the reef fishes all around us. We were happy there, lost in the maze of beauty. It started to squall above, but from the direction of the wind the crew gave no alarm. The signs were not those of a hurricane. But a sudden lurch of the chamber told me a heavy surge had rolled over the bottom of the sea. The fish scattered into the reef holes. Then came a long roll over the sea floor. This surge goes out like wireless—spreading its waves far in advance of a great storm. Sharks scurried by, wildly excited, while others gulped great mouthfuls of water and settled heavily to the bottom. A monster devilfish, straining with all speed, curved about with a dozen big amberjacks nesting on his broad back like circus riders.

Courtesy Brooklyn Museum.

A large specimen of an octopus suspended from the ceiling of a museum.

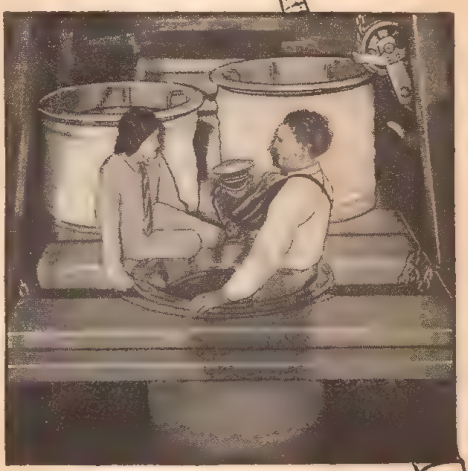
We went to the surface to investigate and the excited voices of the colored boys relayed the news from a smack full of native fishermen, whose eyes were popping out with

fright as they flew to shelter in their frail craft. They shouted "big storm coming," for in some mysterious way the news had reached them from the Nassau Weather Bureau that "a tropical storm of intense severity" was indeed on its way. We were right in its path. Our barometer was dropping like mad. We lost no time in getting away from the reefs to the nearest shelter with our outfit, and none too soon, and though wet and strained to the breaking point, we weathered the storm that took its tremendous toll in lives and wrecked so many homes in Florida and the West Indies.

But don't let this experience worry you now. Our little squall has passed by. It was merely a flurry. The flood of sunlight again lights up the sea floor, as our chamber rests closely to the bottom where I have lowered it again, down into this amazing location. There's a sight coming soon that will thrill you, for I am taking you to a forest of coral. Hello! A parrot fish pays us a visit. Right at our window. He is two feet long and must weigh at least forty pounds. Observe the sheen of his blue-green body. In his parrot-like mouth are deep green teeth as hard as flint. This spells trouble. See that! He drives at the glass and cuts a z-shaped scratch with his teeth. He is fighting himself in the looking-glass, for over this white bottom our window mirrors his image. If more parrot fish get the looking glass signal for fight we will have to move off quickly.

A school of them beat me off once before. They wheeled about in army formation and attacked my glass. They got madder and madder as they hit the blank wall, nose to nose with the reflection in the glass of a gang as angry as they were. What a flash of color their bright-hued bodies made. But two weeks of polishing with many aching arms and backs of my crew failed to remove the scratches and a new glass had to be cast and imported, for these deep-sea windows of mine are several inches thick. Luckily, our visiting parrot fish has changed his mind, though you'll notice that from where he is busy over there he keeps his eye on us as he bites into the trunk of that stoney coral post. His eternal appetite has stayed his fighting spirit. He is now grubbing for marine worms, and to find them he can crack up that coral just as a parrot breaks a cracker with his beak.

Up and around to our left is an extraordinary feature of the sea bottom, for it drops sharply off into the blue, one mile deep. Clustered along the edge of the ocean wall bristles a forest of golden-brown palmate corals, tree-like forms some twenty feet high and still growing, though they are as dead as a tombstone. The only living part of them is the film of animal life, the swarm of coral polyps ever building.



With baby in a knapsack, the explorer and his wife are shown about to descend to their studio many fathoms under the surface. Additional sections of the tube may be seen in the background.

Through this region of submarine marvels I have cruised with my family of three. Our baby is at home down here now, and do you know, we have found that fish are very much like people. They have their likes and dislikes and queer habits. There are even eccentric individuals among them. There is, for example, a very dictatorial fellow who goes about trying to make other fish do things the way he wants them done. There are hermits who insist on swimming off by themselves and avoiding the society of their kind. There are huge companies that travel about under the command of a single leader and which turn about like a regiment at the obvious command of this general, and we have also learned in our curious experience that fish can show affection. Often a pair of fish meet mouth to mouth, and act like human lovers just wrapped up in each other. The light is

(*Continued on page* 1051)

An undersea encounter with a giant octopus, which appears in one of Mr. Williamson's films.

"Duck" Plane Appears to Fly Backwards

By Dr. Alfred Gradenwitz

IN the January issue of SCIENCE AND INVENTION there appeared a short reference to a new type of airplane which has been christened The Duck, because of its appearance. When viewed from the ground it appears to be flying backwards. The new plane is still being tested by its inventors, Messrs. Focke and Wulf, at the German Aeronautical Testing Station at Templehof Aerodrome, Berlin. The main claims for the new design are that it is foolproof against stalling in the air and capsizing when landing.

The Duck in the air, as seen approaching another plane.

The main distinctive feature of the craft is the arrangement in front of the main wing of a forward wing structure which is designed to secure longitudinal stability and serve as the horizontal elevator. The angle between the fore and main wings, and the resulting higher load on the small fore-wing, as well as the position of the centre of gravity in front of the main wing, are responsible for the improved stability. As the angle of inclination of the fore-wing, or elevator, is increased, it reaches its maximum lift in advance of the main wing, so that even gross mistakes on the part of the pilot will not result in any critical condition liable to jeopardize the transversal stability and control of the plane.

The fact that The Duck can not capsize on the ground is due to the position of its centre of gravity, which is well behind the leading ground-contact point, viz., the front wheel. In fact, it is entirely possible with complete safety to apply the wheel brakes hard, thus reducing to a minimum the length of run when landing. Moreover, in the event of a crash, the peculiar design of the new airplane with its projecting forepart will provide better protection to pilot and passengers than will standard airplanes, for the forepart will absorb the initial shock and reduce considerably the risk of damage to the passenger cabin further aft.

The control surfaces situated in front of the main wing also facilitate the pilot's task in judging the position of the airplane in the air. Another very important advantage is that the new plane is entirely free from any horizontal non-carrying surfaces, which only give rise to additional head resistance without contributing to the lift. Both the elevator and the rudder of The Duck are used to increase the lift of the craft: in fact, it is stated that they even carry a relatively heavier load than the main wing. It is further claimed that in the event of the failure of one of the engines, it is possible to fly straight on without losing altitude simply by elevating the forward structure to a suitable angle.

The following are a few details from the specifications:

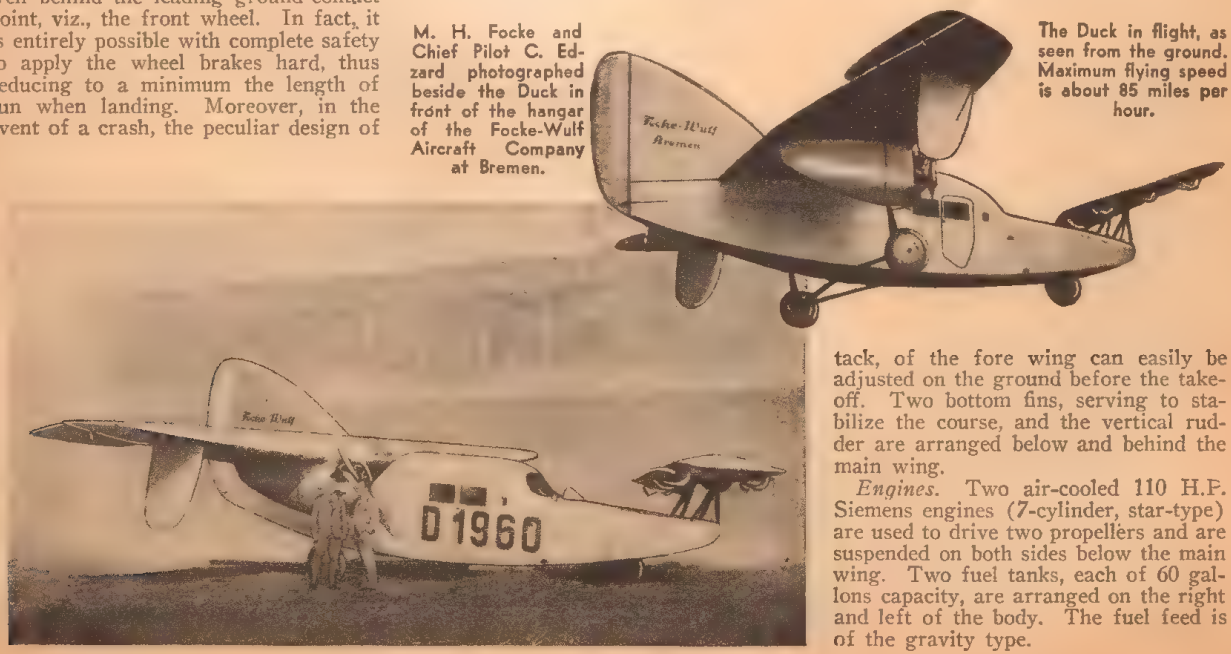
Carrying Surface. The Duck has been designed as a cantilever parasol plane, the thick-profiled wing being inclined upwards at the ends to give it a slight V-shape. The small fore-wing is of trapezoidal shape, its front or leading edge running in a straight line. Both main and fore wings are made of ply wood.

Body. The body, terminating at the stern in the lateral control surfaces, drops half-way between the fore and main wings to two-thirds of its height and terminates at the fore end in a point which carries a small steel tube, fitted with a landing wheel. The high portion of the body immediately ahead of the main wing constitutes the cabin, in front of which is the pilot's cockpit. The cabin accommodates three passengers. The framework of the body is made of welded steel tubing.

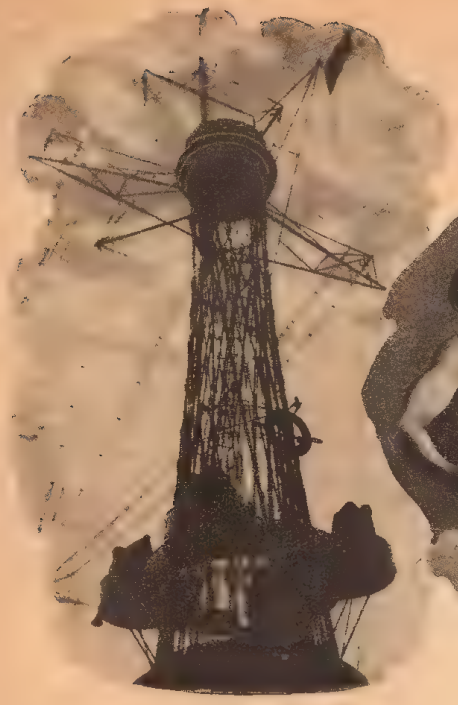
Control Surfaces and Rudders. Ailerons of the usual type are fitted to the ends of the main wing, and horizontal steering is by means of two narrow slotted rudders adjoining the fore wing. The angle of inclination, or attack, of the fore wing can easily be adjusted on the ground before the take-off. Two bottom fins, serving to stabilize the course, and the vertical rudder are arranged below and behind the main wing.

Engines. Two air-cooled 110 H.P. Siemens engines (7-cylinder, star-type) are used to drive two propellers and are suspended on both sides below the main wing. Two fuel tanks, each of 60 gallons capacity, are arranged on the right and left of the body. The fuel feed is of the gravity type.

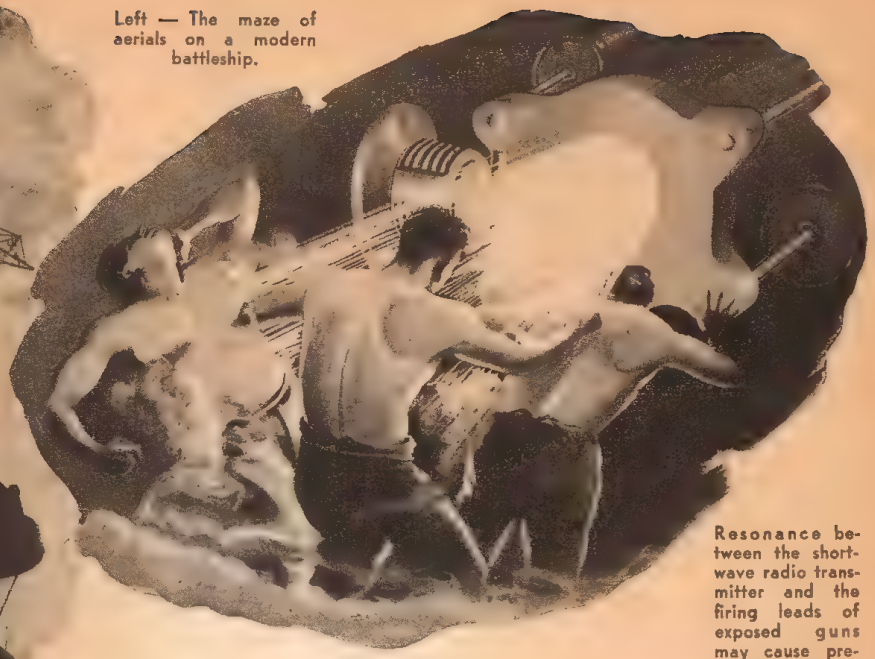
M. H. Focke and Chief Pilot C. Edzard photographed beside the Duck in front of the hangar of the Focke-Wulf Aircraft Company at Bremen.



The Duck in flight, as seen from the ground. Maximum flying speed is about 85 miles per hour.



Left — The maze of aerials on a modern battleship.



Resonance between the short-wave radio transmitter and the firing leads of exposed guns may cause premature firing.

Short-Waves Menace Battleships

By Martin Codel

ANOTHER war may find radio waves guiding pilotless ships, tanks and airplanes into action against an enemy. Possibly even the gunnery will be controlled by radiomen safely ensconced at their controls far from the scene of the fighting but enabled, by television, to watch the performance of the craft they are guiding by remote control.

Yet radio, so the engineers of the United States Navy have found, sometimes proves far from an unmixed blessing in the safe handling of one of Uncle Sam's men o' war.

At least the high frequencies, or shortwaves, have their hazards—and they are real hazards too. So real that the former chief of naval operations, Admiral Hughes, felt constrained to issue an order to all ships and stations of the Navy to take every necessary precaution against what he officially termed the "hazards of high frequency."

"Hazards away," thereupon sang the Navy's radiomen, gunners and technical officers, paraphrasing the famous lay of the Middies.

Admiral Hughes' order succinctly stated what was in the minds of the Navy's experts when they urged that, until exhaustive tests on board ship have demonstrated conclusively just what danger to explosives and guns attends the use of high frequency radio transmitters, certain extraordinary safety precautions should be observed. Wrote Admiral Hughes:

"No radio transmitter on board ship shall be operated on frequencies above 4,000 kilocycles (75 meters) when the following conditions hold:

"1. During target practice when powder is out of the magazines.

"2. When fueling ship with fuel oil or gasoline.

"3. When wing-tip flares are installed on planes and the flares are near objects which might be seriously damaged or cause serious damage as a result of the flare igniting. Wing-tip flares should only be installed in planes when necessary."

Moreover, the order continued, no radio transmitter shall be operated on frequencies above 4,000 kilocycles while aircraft or boats are being fueled on deck.

Why all this precaution? Can it be that the invisible waves of radio actually will touch off a big gun, cause fuel tanks to explode or ignite wing-tip flares? Precisely. No report of actual damage from the hazard has ever been given out by the Navy, but that the hazard exists as a potential source of danger to life and equipment is readily recognizable from the following report, also under the signature of Admiral Hughes:

"Investigations have been conducted in the fleets and, under the direction of the Bureau of Engineering and Ordnance, at the Naval Radio Laboratory, to determine what, if any, extra fire or explosive hazards may be introduced by the use on shipboard of high frequency radio transmitters.

"It has been known for years that currents of (*Continued on page* 1026)

Battleships of the U.S. Navy at battle practice. The second ship in line has just fired a big gun broadside.

Science Pops Corn by Radio and Freezes Light Rays

THE greatest liar on earth, Baron Munchausen of fiction, went so far north that the ring of a bell was frozen. He brought back the frozen sound and thawed it out to the plaudits of an astounded audience. Was he a liar or only a prophet? At any rate, he has just been out-Munchausened by two scientists who plunged some light into liquid air, carried it from Schenectady to New York City, and then thawed it out, one color at a time.

These same two wizards made pop-corn pop by radio. Kernels in a transparent bag mysteriously exploded into white puffs when the bag was placed between two glass jars in which ice cubes were floating.

They made sound visible and light audible. They caused the smallest voice in the world to be heard by thousands. They turned on a brilliant incandescent lamp by lighting a match. Atoms were made to serve as broadcasting stations, and liquid air served as the explosive in a novel type of cannon.

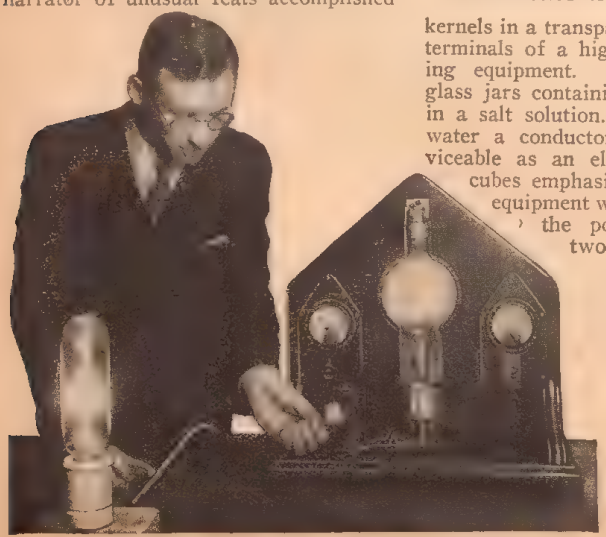
Nearly two thousand members and guests of the Merchants' Association of New York witnessed thee demonstrations of the impossible when L. A. Hawkins, executive engineer, and E. L. Manning, physicist, of the research laboratory of the General Electric Company gave a demonstration of "Gulliver's Travels among the Real Lilliputians of the Universe" at a luncheon meeting of the association on December 4 in New York City. The speakers were introduced by Floyd Gibbons, radio narrator of unusual feats accomplished in Schenectady's "House of Magic." The luncheon program was broadcast by a number of radio stations.

One of the features of the demonstration was the placing of some pop-corn kernels in a transparent bag between the terminals of a high-frequency generating equipment. The terminals were glass jars containing ice cubes floating in a salt solution. The salt made the water a conductor and therefore serviceable as an electrode, and the ice cubes emphasized the fact that the equipment was cold—even though the pop-corn between the two jars immediately began to give off steam and soon to pop audibly. Two minutes were sufficient for popping the corn—and the bag was not burned or even browned. The corn was hot, and no charred kernels were to be seen.

The smallest voice in the world, that of the atom, broadcasts. E. L. Manning with the Geiger apparatus.

Talking light and visible sound. E. L. Manning holding the photoelectric cell. The neon lamp is visible on the table before him.

Corn being popped between iced-water electrodes connected to high-frequency heater.



"Lighting" a 1000-watt incandescent lamp with a match. Light from the match acts upon the photoelectric cell, which controls a thyratron relay which, in turn, allows current to pass.

The wavelengths used in ordinary radio broadcasting are a few hundred meters long. For long-distance, point-to-point radio it has been found advantageous to use much shorter waves, of 20 to 30 meters. It was desired to explore the possibilities with still shorter wavelengths in the research laboratory, and difficulties of tube design were overcome so that a power tube that would work on five or six meters was produced.

Using the new tube, it was discovered that such short waves produced a fever in anyone subjected to them for a few minutes. This interested the laboratory workers, for fever is Nature's way of combating infection, and it looked as though a new and valuable tool had been made available to doctors—a tool that would produce artificial fever under exact control, with no bad after-effects.

A number of sets like the one used in the pop-corn demonstration were built in the laboratory, and placed in various medical research institutions. The artificial fever treatment has been used with striking success on a wide variety of ailments in man and animals, Mr. Hawkins said, but it is being left to the doctors to report the results.

Baron Munchausen, reputed the world's biggest liar, told a big one when he described his frozen sound, but today he has been outdone by a demonstration of frozen light. One of the effects that the cathode-ray tube produces is to cause some substances to become brightly fluorescent, or to give off light even after the raying has been stopped. Different colors of light are produced by different substances, and different colors are also produced by a substance at different temperatures.

The cathode-ray apparatus occupied too much space to be transported readily from Schenec- (*Continued on page* 1039)

It Is Safer to Kiss a Dog

How Great Is the Danger to Your Child's Health When He Fondles a Pet Cat, Dog, Rabbit or Parrot? Much Less Than When He Kisses You, Declares This Famous Physician

By Frederick Damrau, M.D.

These youthful sweethearts don't seem at all worried by the fact that 40,000 germs are exchanged in one kiss.

ANY physician will tell you it is safer to kiss a cat or dog than a human being. Little Mary catches her colds by caressing the neighbor's child while she still has the snuffles. It is a case of contagion from nose to nose or mouth to mouth. She probably caught measles and whooping cough in the same way. And, unless Mother is careful, that is how she may some day become very ill with diphtheria or scarlet fever.

If I keep pets in the home, will I be endangering the health of my family?

Since the discovery that rabbits commonly carry tularemia, and more recently that parrots are responsible for the new disease with the unspellable name, many mothers have anxiously asked their doctors this question.

Compared with these common and serious diseases, the dangers of household pets are not great. With respect to their ailments, animals have castes. Dogs, for example, die of maladies that hardly affect man at all. On the other hand, a human affliction may attack every member of a large family and yet leave the cats and dogs in perfect health.

Unfortunately, you cannot rely too much on this general rule. Some diseases, including the newly discovered affliction *tularemia* and *psittacosis*, affect both man and the lower animals. If your child has wild jack rabbits as pets,

What price psittacosis? Miss Adrienne Brune, with the parrot she has trained for her operatic success, "Polly."

and they happen to be infected with tularemia, there is grave danger. Or, if you have purchased a parrot recently imported from South America, you will do well to make sure that it is not ill with psittacosis.

If one were asked to name the most universal ailment of dogs, the answer would be *worms*. Throw Fido a joint of beef and, so long as it is red, raw and juicy, he will polish the bone. He shows no fastidiousness whether the meat be government inspected or refuse from the abattoir.

As a result, every member of the canine family from the aristocratic lap-dog to the stray mongrel is only too likely to be a carrier of worms. But these parasites, while unpleasant to think about, are generally not dangerous to us. In the first place, many of them do not bother man. Again, most of the tapeworm and other infections of this type affecting man are contracted by eating raw or insufficiently cooked flesh, not by caressing or handling animals.

The camaraderie existing between the huntsman and the hounds is, most likely, in no way detrimental to the young man's health.

There is, however, one tapeworm, fortunately rare in the United States, which may be carried from dog to man and cause serious disease. It is the tiny dog tapeworm, measuring only one-fifth of an inch in length and consisting of only three or four segments, which when it infests man forms cysts that are carried to the liver, lungs and other organs.

A number of stray dogs become infested by being allowed to feed upon offal from carelessly managed slaughterhouses. So your child might become contaminated by fondling a stray dog and then eating with dirty hands.

People living in the neighborhood of a poorly conducted slaughterhouse must watch out.

The most terrible disease that may be transmitted by the dog is *rabies*, or *hydrophobia;* but infection occurs only when the animal suffers from it.

Even when one is actually snapped by a dog, there is no danger of contracting rabies unless the animal itself has the disease. But, whenever one is bitten—no matter how innocent the bite may appear—he should report to his physician at once and have the dog seized for observation by the health department. Any policeman, when notified, will see that this is done.

(*Continued on page* 1028)

Why Electric Clocks Keep Time

By George E. Fleming

Above—The master clock at the Hell Gate Station of the United Electric Company in New York City. Left—A view of the Hell Gate Station, which is the largest power station in the world.

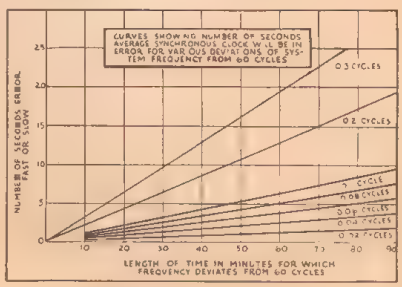
ELECTRICITY, that versatile servant of man, has been assigned many tasks that make our existence easier. Not only does this modern genii turn our nights into day, run our electric trains, and furnish us with music that originates in some studio perhaps a thousand miles away, but even the inevitable passage of time is now marked with electric clocks.

The synchronism of two moving parts is not new. In fact, for many years the principle has been in use, but the availability of inexpensive, highly accurate timepieces, whose action is dependent on the maintenance of accurate frequency of alternating current, is very recent. Now, one can purchase at the corner store, for about ten dollars, a clock that will keep better time than one purchased a few years back for several hundred dollars. In fact, assuming that there is no interruption of your electric service, the variation over a period of months will be a matter of not more than two seconds. The only real drawback to the idea is that one is deprived of the alibi of forgetting to wind the clock when the 8:15 is missed in the morning!

Left—Time, day and date are visible at a glance on the face of this new Hammond all-electric clock with an automatic date-recording device. The day and date are registered at the bottom of the clock dial by means of two drums which click off each succeeding date at the stroke of midnight. This new timepiece is the first of its kind, and operates direct from the A.C. lighting mains for a few cents a month.

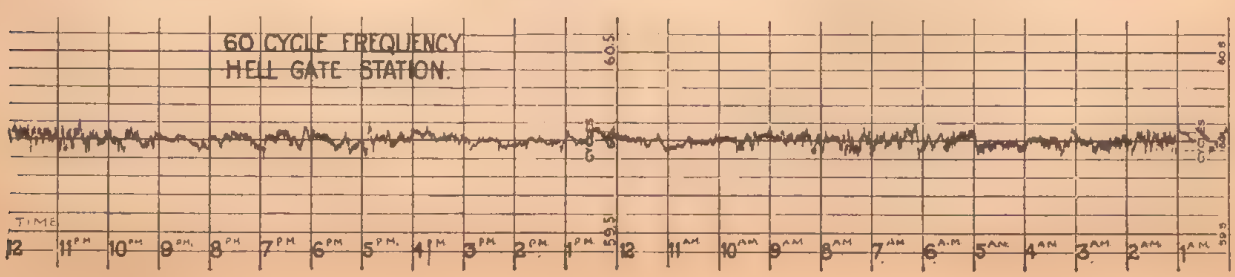
We would like to think that our electric company goes to very great pains to maintain a constant frequency so that our clocks shall keep correct time, but this is not the case. In reality, the converse is true, we are able to have these timepieces because the frequency is kept constant. Of course, nowadays, our clocks are an added incentive, but long before anyone thought of widespread usage of the lighting lines to this end, devices were designed to maintain a frequency within very narrow margins. The outstanding reason for this is the fact that not at all infrequently two or more generators are used in parallel to supply current, each generator being independently driven from its own source of power, such as a steam engine. Sometimes these two generators are in the same location, but more frequently they are miles apart. Now, two generators operating on the same frequency assist each other, but if the frequency is allowed to vary over any appreciable margin, the A. C. impulses no longer coincide, and instead of assisting each other, they might actually buck each other, so that the resultant output would be very low. This loss of efficiency could not be tolerated, of course, so means had to be found to keep individual generator frequencies within very narrow margins. Incidentally, in practice, more than two generators are very often hooked together.

Besides the loss of efficiency, other reasons presented themselves to the engineers of the electric companies for the accurate maintenance of frequency. Both syn- (*Continued on page* 1023)


CURVES SHOWING NUMBER OF SECONDS AVERAGE SYNCHRONOUS CLOCK WILL BE IN ERROR FOR VARIOUS DEVIATIONS OF SYSTEM FREQUENCY FROM 60 CYCLES
0.3 CYCLES
0.2 CYCLES
0.1 CYCLE
0.05 CYCLES
0.02 CYCLES
0.01 CYCLES
NUMBER OF SECONDS ERROR, FAST OR SLOW
LENGTH OF TIME IN MINUTES FOR WHICH FREQUENCY DEVIATES FROM 60 CYCLES

Left—Fig. 2—Curves showing just how many seconds in error an electric clock will be if an error in supply frequency persists for a given length of time.

Below—Fig. 1—This graph was made on a recording frequency meter, and clearly demonstrates that the maximum deviation from 60 cycles is less than one tenth of a cycle over a period of twenty-four hours, and even this minute deviation is corrected by an equal deviation in the opposite direction.


60 CYCLE FREQUENCY
HELL GATE STATION
60.1
60.0
59.9
CYCLES
TIME
12 11PM 10PM 9PM 8PM 7PM 6PM 5PM 4PM 3PM 2PM 1PM 12 11AM 10AM 9AM 8AM 7AM 6AM 5AM 4AM 3AM 2AM 1AM

Some Outboard Stunts You Can Do

By J. Phillips Dykes

Rear Commodore and Secretary, American Outboard Association

A hair-raising stunt—leaping in an outboard through a wall of fire. The secret of this and other stunts is fully explained in the text.

Water polo, a fast and exciting game where the players ride on "ponies" attached to surf boards which are towed behind outboard boats.

HUNDREDS of letters have come to my desk from outboard fans all over the country, asking how it is possible to pull off some of the breath-taking outboard stunts that have been seen in the motion picture theatres, particularly in news reels, in the Sunday rotogravure sections and in such magazines as SCIENCE AND INVENTION.

I did not pay much attention to them at first, but since every mail brings a new flock of letters I have at last succumbed to popular demand and am laying bare a few of the secrets of the world of outboard "stunts" as practised by that sterling team of water acrobats, the Popes, Kerr, Fraser and others.

The boys were a little reluctant to disclose their secrets at first, but after much persuasion and a few glasses of good old Florida lemonade they gave in, and here goes!

All the daredevil movie stunts did not originate in Hollywood, for the Pope brothers, Malcolm and Dick, and their partners, Jack Kerr and Harrison Fraser, all of Winter Haven, Florida, evolved a series of breath-taking stunts, the redeeming feature of which was the proximity to a soft landing surface, the water of Florida's lakes. These chaps were the originators of the famous jumping boats that fly through the air, through walls of fire, through paper hoops; of tiny speed outboard races in swimming pools; of boats with wings which actually leave the water; and of aquaplanes which fly up and over slanting platforms with the rider taking a sail of over thirty feet through the air before landing. Countless newsreels, newspaper and magazine pictures have shown these startling antics to the American people, and now we find that there is an inside to this remarkable series of stunts, and we prevailed upon Malcolm Pope to give the readers of SCIENCE AND INVENTION an exclusive interview on how these stunts were staged.

A startling stunt that made the aviation world as well as the boating world gasp—the "flying" of an aquaglider, an aquaplane over which a small wing is constructed.

Jousting with aquaplanes is thrilling and "wet" enough to suit most anybody.

The first one is the jumping or flying boat. It was about two years ago when unretouched pictures of an outboard boat flying through the air first appeared, and many people thought the daredevil that rode in this boat would surely be killed if he ever attempted it again. Actually Pope, Kerr and Fraser have repeated this stunt one hundred times each without so much as a black and blue spot. In his own words, we give Malcolm Pope's explanation of the simplicity of this startling act.

"First a wooden platform should be built ten feet wide and fourteen feet long, out of one by ten dressed planks. Two watertight barrels are then placed on the under side of this platform in a secure manner. A few two by fours will hold them there perfectly. Then you have four anchoring ropes, and after you pull the platform into the position you want with the smooth side uppermost and the barrels underneath, the ropes to which heavy weights or anchors are attached are (*Continued on page* 1038)

A close-up of the warrior ant, enlarged. He moves with great rapidity and it is necessary to hurry to keep out of his way when he is on the war path.

Ants Fight

By Don Charles

THE ant nations of the world have no peace treaties, no league, no disarmament conferences. They are followers of Mars, the great red god of war.

Ant wars have been in progress in the Zoological Gardens of the nations —in England, in New York, in Washington and elsewhere. Ant wars are raging in Africa, in South America, in fact wherever rival ant nations or tribes meet war is declared and then it is a battle to the finish, with no quarter asked or given.

H. G. Wells has foreshadowed a sinister possibility — the evolution of the warrior ant to tiger-size. Imagine, if possible, the havoc of great armies of such giant creatures, marching a million strong, to battle for the supremacy. Fighting would be so fierce that rather than release a domestic creature such as a horse or a cow upon whom they chanced, they would allow their heads to be cut off!

The tiny ant is most like the human in living conditions. Ants have their cities, their various social orders, their rulers. For this reason the ant's habits have engaged the attention of scientists who are studying them.

Sometime ago the officials of the London Zoo staged an ant battle in their study of ant behavior. The keepers

The warrior ant is perfectly capable of winning any combat with a bee or a hornet. Here is one carrying such a prize back to augment the tribe's food supplies.

turned a thousand or more loose, permitted them to attack one another, and before the melee was over several hundred had been killed and large numbers badly wounded. Excited spectators viewed the fight.

The most remarkable thing about the whole battle was the way the opposing armies planned their campaigns and conducted their attacks. It was a demonstration that the ant can use his brains in the heat of battle, as well as in the calmer days of peace. It all started on a bright Monday morning, when one of the keepers of the zoo placed a little wooden chip over the moat that separated two ant nations—an old one that had been there for three years, and a new one just arrived. The chip served as a bridge, and for the first time made possible communication between the two colonies.

A member of the old colony became curious. He sneaked across the bridge and penetrated into the new nest. He never came back.

A police ant arresting an unruly member of the tribe.

At left is a cross-section of an ant hill showing how the paths or streets run together, and the care taken of the eggs. Ants are constantly on guard at the openings. In this picture, the ants are shown pouring out to the attack, marching in regular formation like a human army.

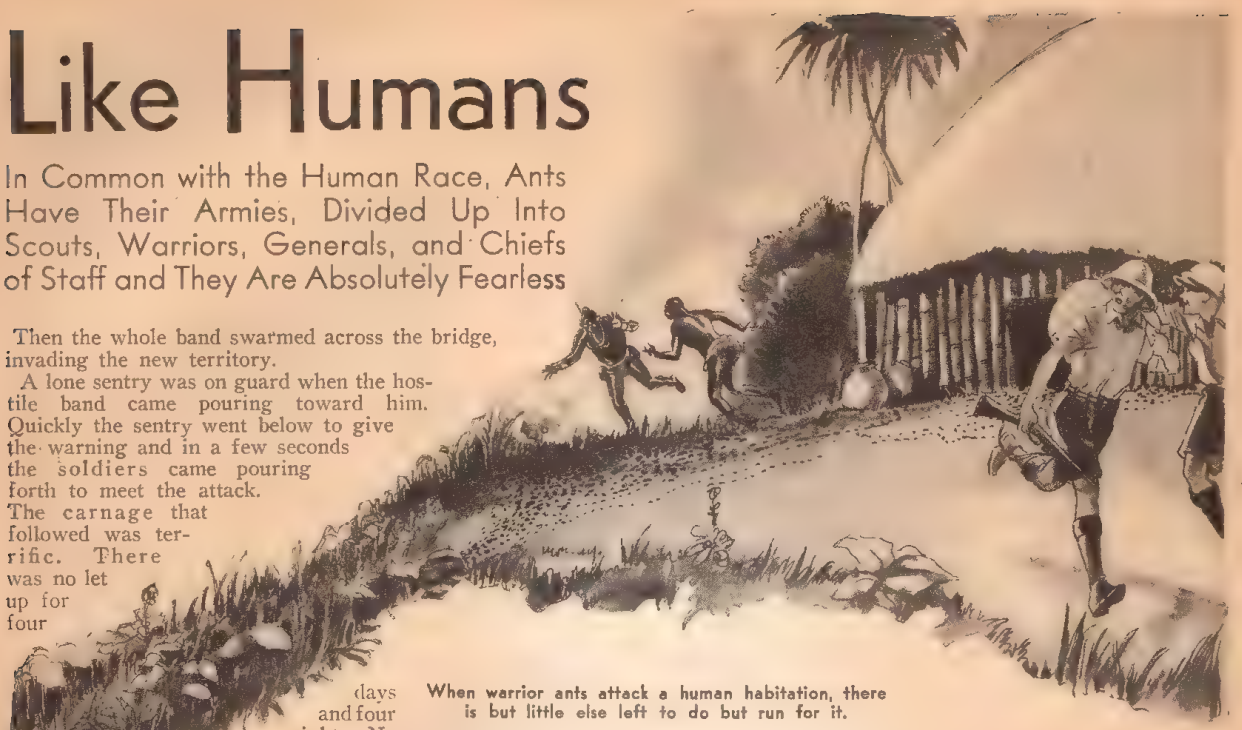
That meant war, the old ants decided. They probably believed that they should protect their nationals. But they did not lose their heads and dash pell-mell across the bridge, only to be swallowed up by a possible ambush. Instead, they chose their best scouts and sent them out to reconnoiter. These daring ants crawled across the bridge and into the enemy's territory.

They found nothing. All the new ants were hidden away, awaiting the advance of the enemy. The scouts went back to the generals and reported.

The zoo keepers and scientists watched closely every move. They noted that a council of war followed the report. In a few minutes there issued from the old nest an imposing array of warriors, marching in ranks as orderly as any crack regiment of infantry. Along beside the column went other ants which threw up earthworks in case attacks might come from such quarters.

Like Humans

In Common with the Human Race, Ants Have Their Armies, Divided Up Into Scouts, Warriors, Generals, and Chiefs of Staff and They Are Absolutely Fearless



When warrior ants attack a human habitation, there is but little else left to do but run for it.

Then the whole band swarmed across the bridge, invading the new territory.

A lone sentry was on guard when the hostile band came pouring toward him. Quickly the sentry went below to give the warning and in a few seconds the soldiers came pouring forth to meet the attack. The carnage that followed was terrific. There was no let up for four days and four nights. No quarter was asked and none given. They fought in small groups, biting and tearing. Warriors were dismembered. Quivering bodies lay legless and headless. So hot waged the battle that only a few of the wounded were dragged aside into temporary safety.

Ants cutting grass.

Then an armistice must have been arranged, but it lasted only a few hours. Evidently the terms were broken for the battle was resumed, and more wounded lay quivering or floating helplessly in the water beneath the bridge. With their big mandibles the warriors slashed at one another. They tossed the weaker ones into the moat; or failing this, cut off their opponents' limbs and left them helpless.

By Thursday afternoon the invaders from the old colony had been driven back across the bridge with great losses; in fact they had been practically annihilated. Their rout was complete. The victors took some for slaves, after killing all that they desired. The worker ants were called out and cleared the dead from the field, and peace reigned.

Scientists say that mankind will one day have to contest the rulership of the world with insects and among all the insects the ants have shown the highest capacity for leadership and the greatest intelligence. If, as H. G. Wells has predicted, ants grow to enormous size, becoming as large as tigers or even as cats and dogs, man would find it difficult to live upon the earth.

In Africa where the ant is very much at home, ants create the greatest havoc among humans because of their fighting instincts and their tenacity of purpose.

Dr. Hans Coudenhove, a scientist of note who has studied the warrior ants in Africa, says that all native life flees before the approach of these ant armies. He tells of sitting in front of his tent or on the porch of his house on an afternoon and noticing that suddenly the harmless brown ants were fleeing in disorderly manner, clutching their pupae or babies, just as peasant women have fled upon the approach of foreign armies in European wars.

If the battle is not too fierce, warrior ants carry their wounded comrades off the field.

This might mean nothing to a newcomer but to the experienced African it means trouble. "He will rise, in haste, call his servants, and say to them:

"'Siafu are approaching; look about everywhere and stop them if you can!'"

Dr. Coudenhove says that the servants need not be told twice. "They start running, and search the surroundings of the tent or house in extending circles, until one of them will sing out:

"'There they are!'"

Then there will be jumps, kicks, and clappings of the palms of the hands on the feet, legs and calves. This is because they have suddenly come in contact with the advance guard of the enemy's column.

"Siafu" is the name that the Swahili tribe have given to the warrior ants, the type of ants that are ready to fight at any time the world over, whether in the zoos of London, New York, Washington, or the plains of Africa.

These warrior ants will attack anything alive that they may meet in the course of their advance. They have disproportionately large heads and mandibles, they are bloodthirsty, and while the wound is not poisonous it is none the less dangerous.

"Caged birds and animals have been killed," Dr. Coudenhove says, "if not rescued in time.

"I remember a case in which they killed during (*Continued on page* 1031)

The warrior ants have been known to bury their dead, laying them out in neat, orderly rows.

Cooking a Banquet in a Fourteen-Foot Box

By Walter Raleigh

In this little fourteen-foot box the serving is done. Every motion counts, and must be right.

IF your wife or your friend's wife complains about getting the dinner in an apartment kitchen, she ought to watch the cooks on a modern railway prepare a hundred dinners in a fourteen-foot box!

And if your apartment kitchen grows warm—hot—from the gas stove and the electric range, and the fumes and cooking odors seep out into the dining room, she, and you, may console yourselves with the idea that the kitchen of to-morrow will probably have adopted the very newest devices of the railways for making the air comfortable, cool, and inviting. Then, although the cabbage may burn and the peas send forth a lively odor, the latest mechanical device will completely do away with it.

Heat, dust, cinders, smoke and noise have been accepted as an inevitable accompaniment of railway travel in warm weather, and oftentimes in winter weather. Sitting down at a dining car table, these factors seem the worst possible. But recent developments in electric power supply, distribution and utilization on a moving train, now take care of these annoyances.

Recently a car on the Baltimore and Ohio Railroad was fitted with these newest features which free the air from dust, soot, cinders and other foreign matter, and at the same time control its temperature and humidity. This was a test car, and the test was successful. Therefore, say the engineers, if it will work on a moving car, it will not be long before it will be found in all the most modern houses.

This is the Pennsylvania Railroad's school for dining car men, who are shown here watching a demonstration of how to cut steaks and roasts.

Then a dining car was equipped. Since space is a prime factor in all dining cars, the devices had to be small and stowed away out of sight. Again it worked, although the full heating capacity of the train was turned on, plus the heat from the kitchen, plus again, a warm day. As a result the temperature dropped from 93 degrees to 70 degrees in 20 minutes, or more than a degree a minute.

A view of the pantry, looking towards the kitchen, showing how every bit of space is occupied with some useful equipment. This is the dining car "Martha Washington," of The Baltimore and Ohio Railroad

The railroads have at last become interested in the comfort of their passengers. In a particular way, if a man is comfortable when he is eating, he feels pretty good for a long time afterwards.

But to get back to these tiny kitchens, the smallest in the world, now automatically ventilated and freshened with washed air while the train speeds. You might never believe it, but the fourteen-foot box contains ice boxes, ranges, broiling and baking ovens, steam tables, dish warmers, work tables, sinks, vegetable racks, and a marvellous, multi-mouthed refuse removal system.

With such equipment the cooks serve an average of seventy-five meals a day year in and year out; and at a pinch they can serve one hundred and twenty-five more. They store, too, their own supplies. And but very, very little of the food comes out of cans. Yet this is all done in a space of five feet wide, and eighteen feet long, and the working space is exactly fourteen feet by two and a half!

To be able to have a good meal on a fast running train is one of the modern conveniences that Americans take more or less for granted these days, like the radio, the telephone, the airplane. But when Rastus eases his groaning tray before you, and you have neatly broiled steak, mashed potatoes and trimmings, and maybe minced ham, creole, with corn fritters, or stewed chicken with dumpling, remember that this all came from the cook stoves of the fourteen-foot box ready for you. In addition the other occupants of the car have their own choices.

How is it done? Not easy, but a well experienced organization makes it seem easy enough. The responsibility falls on the steward in charge of the dining car. It's up to him.

He must (*Continued on page* 1032)

Fig. 2:—Photograph of the asteroid Ceres. The planet's motion during exposure is plainly evident by its trail, the star images remaining circular.

The Pygmy Planets

Astronomers Take Advantage of the Near Approach of Eros to Make Improved Measurements of the Solar System

By Dr. Donald H. Menzel

Lick Observatory, Mount Hamilton, California.

JANUARY 30, 1931, marked an important event for astronomers, for on that day, the planet Eros was nearer the earth than at any time since its discovery in 1898. Eros? To our ears the word has an unfamiliar ring that even its frequent appearance in cross-word puzzles —a four-letter word for planet —has not been able to remove. And why should such an occurrence have a special significance? To better appreciate the situation, we must go back in history.

Few people realize that the planets in the solar system number up into the thousands. From these, the Planetary Social Register, now that Pluto's claim for recognition is generally admitted by the astronomical arbiters, selects only nine as worthy of the special distinction of being dubbed the major planets. Size is the chief characteristic that marks the élite. The aggregate mass of the thousands of minor planets is far less than the mass of even the smallest major planet. Giving a liberal allowance for the contribution of minor planets yet undiscovered, the total mass probably does not exceed 1/500 that of the earth.

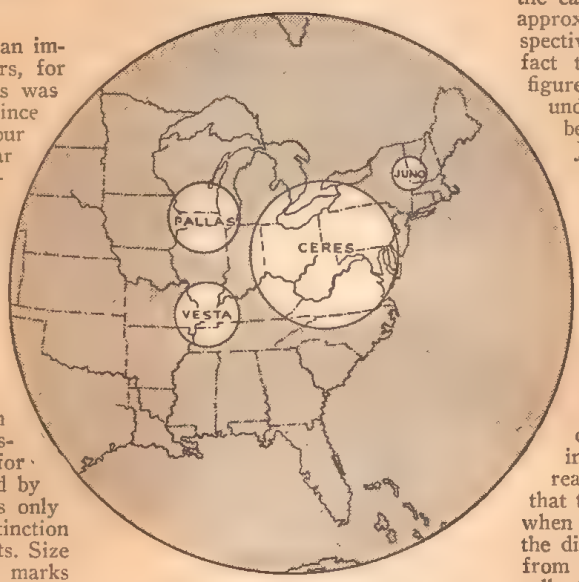


Fig. 1:—Some of the asteroids compared with the Eastern United States.

The discovery of the minor planets—asteroids or planetoids as they are frequently called—is of considerable interest. In 1772 Bode pointed out a curious relation exhibited by the distances of the various planets from the sun. Write down a line of 4's. To the second 4 add 3; to the third add 3×2 or 6; to the fourth 6×2 or 12; and so on, doubling the number each time. Then divide the result by 10 (i.e., point off one decimal place).

4	4	4	4	4	4	4	4
	3	6	12	24	48	96	192
.4	.7	1.0	1.6	2.8	5.2	10.0	19.6
.39	.72	1.0	1.52		5.20	9.54	19.2
Mercury	Venus	Earth	Mars	?	Jupiter	Saturn	Uranus

The second series of numbers set just below the first represents the distances of the various planets from the sun, the earth's being taken as unity. The approximate correspondence of the respective pairs is very striking. The fact that no known planet gave the figure 2.8 led Bode to suggest that an undiscovered planet lay somewhere between the orbits of Mars and Jupiter. The discovery of Uranus, which was unknown when Bode enunciated his law, and its approximate conformity to the prescribed distance, 19.6, served to strengthen belief in Bode's contention.

It fell to the lot of the Sicilian astronomer, Piazzi, to make the notable discovery of Ceres, with a distance approximating 2.8. On January 1, 1801, the very first night of the nineteenth century, he observed a faint star in a position where he was sure no real star should be. He soon found that the object was not stationary and, when its orbit was finally calculated, the distance of the newly found planet from the sun proved to be 2.77, in excellent agreement with Bode's prediction. This (*Continued on page* 1033)

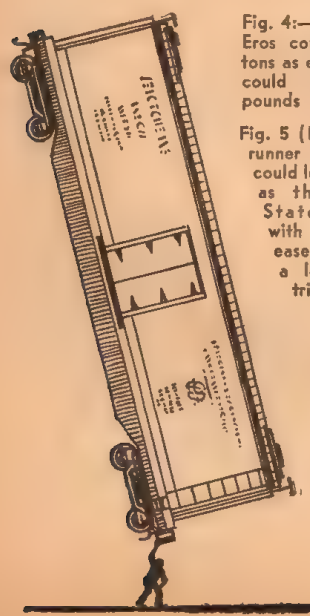
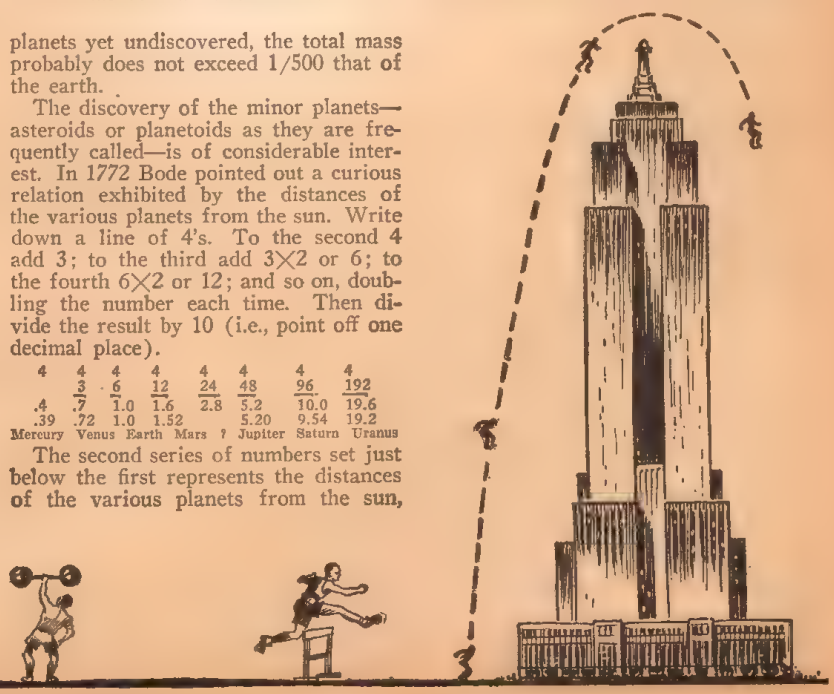


Fig. 4:—A man on Eros could lift 30 tons as easily as he could lift 100 pounds on earth.

Fig. 5 (Right):—A runner on Eros could leap as high as the Empire State Building with the same ease as he could a low terrestrial hurdle.



Andrée's

Sailors at work on the top of the balloon just before the start of the ill-fated flight.

SCIENCE AND INVENTION is the only magazine of its type to acquire the exclusive right to publish the accompanying photographs and extracts from Andrée's diary. Copyright, 1930, in the United States of America by Hearst Enterprises, Inc. Copyright throughout the world by Albert Bonniers Forlag. All rights reserved. Reproduction in whole or in part prohibited.

A general view of the balloon house at Dane's Island, Spitzbergen, prior to the commencement of the flight.

Andrée (left) photographed beside the balloon basket in the balloon house.

THE lure of the unknown has proved an irresistible attraction to man right down through the ages, and one of the most fascinating forms which this natural inquisitiveness has taken is exploration. In particular, man has been drawn to attempt to solve the silent, icebound mysteries of the Arctic and Antarctic regions. Expedition after expedition has gone forth in attempts to reach the North and South Poles, the majority to return defeated by impenetrable ice barriers—many never to return at all. Their fate? Who knows? In the cases of the majority of those who have heroically sacrificed their lives so that the store of human knowledge might perhaps be augmented, we can but guess at the terrors amid which they departed this world, and the manner of their going.

Occasionally, some following expedition stumbles across remains of its predecessors, a food cache, some discarded equipment, a skeleton or, in the Arctic and Antarctic regions, perhaps the preserved body of some explorer who lost his life many years previously. Sometimes, in such cases, it is possible from written and still intelligible records to piece together the dreadful story of suffering which led to death from sickness, starvation, or intense cold.

Science has done its utmost to aid these fearless adventurers into the unknown. Each succeeding expedition has gone forth with more and better equipment than its predecessor, culminating most recently in Admiral Byrd's highly successful expedition to the South Pole, which was fully and completely equipped with all the latest aids known to science, including airplanes.

Aircraft have been used on several occasions by recent Polar expeditions, but the honor and glory of being the first Polar aeronauts remains with the Swedish explorer, Saloman A. Andrée and his two companions, Nils Strindberg and Knut Fraenkel, who left Dane's Island, Spitzbergen, in a free balloon on July 11th, 1897, hoping that the wind would cause their balloon to drift over the North Pole and towards some land upon which they could alight and return to civilization. They never returned and, although rescue expeditions were sent to look for them, nothing was heard of them until August 6th, 1930, when a Norwegian scientific party accidentally came across their remains in a desolate camp on White Island, a small isolated island about 60 miles to the east of Spitzbergen.

But amid the silence the explorers had left behind something articulate—the diaries and notebooks of Andrée and Strindberg. From these now comes for the first time the whole story of the ill-fated flight of the explorers, of their terrible months of ice wandering, and their last heroic fight against death.

Andrée's diaries were found when the bodies were first discovered; the diaries and records of Strindberg were recovered soon afterwards by an expedition to White Island which was sponsored by the Hearst Newspapers.

All were taken to Stockholm. Under the auspices of the Swedish Government they were turned over to the Swedish Society of Anthropology and Geography, which placed them in the hands of an eminent committee of scientists, Professors Ahlmann, Anderson and Lithberg.

Some parts of the diaries and records were illegible. Many pages contained data of a purely scientific nature, such as barometric, meteorological and navigational observations, etc. But above all, they contained a continuous and faithful record of what happened to the explorers throughout their tragic adventure. These writings, ice-locked in the North for thirty-three years, have been deciphered by the Swedish scientists and reconstructed into a sequential narrative, an imperishable saga of high courage against hopeless odds, the greatest of all epics of the Arctic.

Photos Reveal His Fate

The Successful Development of the Thirty-Three-Year-Old Films Which Were Found Among the Remains of the Ill-Fated Andrée Polar Expedition Constitutes a Scientific Triumph. The Pictures, Some of Which Are Reproduced Here, Provide Vivid Illustrations for the Thrilling Tale of a Gallant But Hopeless Battle Against the Invincible Arctic Ice

Salomon August Andrée (seated) and his two companions, Nils Strindberg (left) and Knut Fraenkel (right) discussing plans shortly before they left, never to return.

In addition to the written records, Andrée and his companions left undeveloped photographic films, and the manner in which they were developed and made to yield up their part of the story is a triumph of modern scientific achievement. Many of the films were irretrievably ruined by their thirty-three years of exposure to the elements, but sufficient were saved to provide a very complete pictorial record of the ill-fated expedition. Some of these original photographs are reproduced on these pages, and the manner of their development will be described later.

Something of the spirit which inspires explorers and other seekers after the unknown, was captured by Andrée himself, who, while still in the air in his balloon, wrote as follows:

"It was not a little strange to be floating here above the Polar Sea. To be the first that have floated here in a balloon. How soon, I wonder, shall we have successors? Shall we be thought mad or will our example be followed?

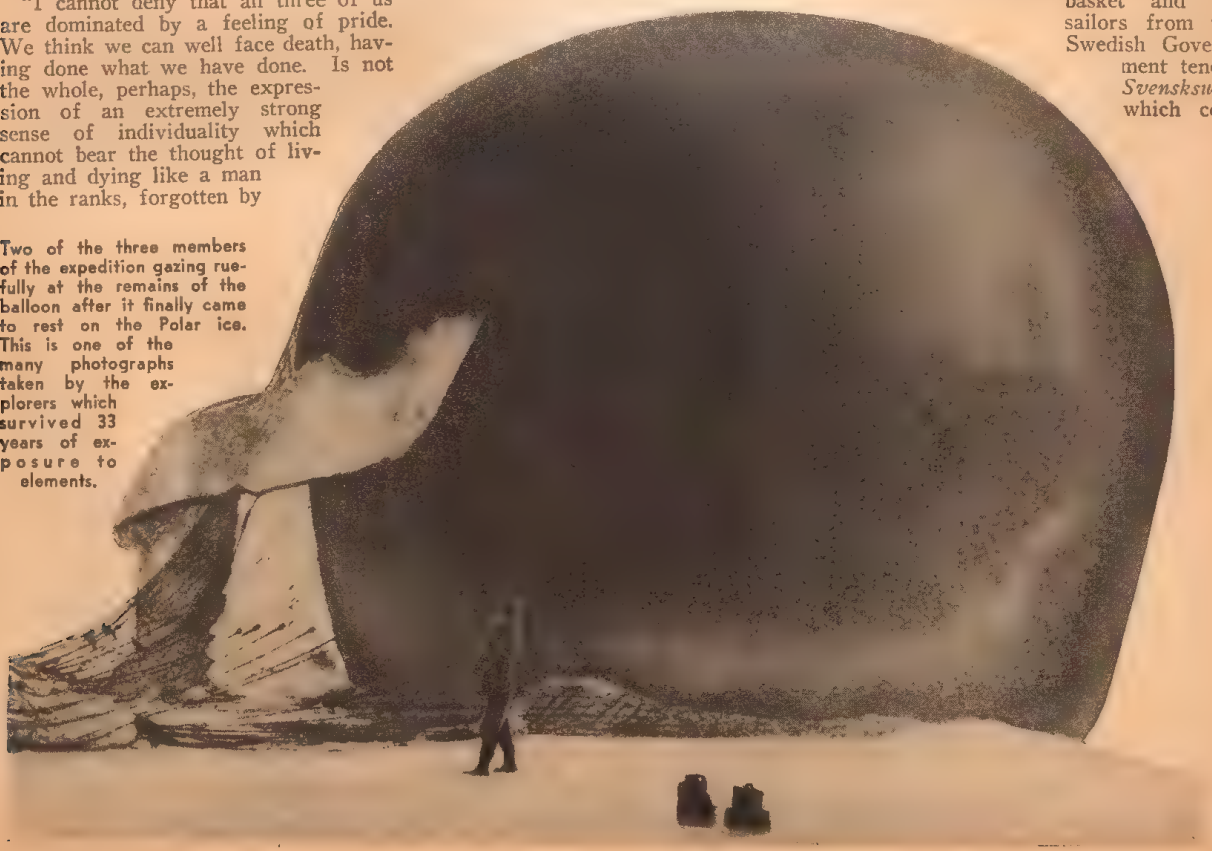
"I cannot deny that all three of us are dominated by a feeling of pride. We think we can well face death, having done what we have done. Is not the whole, perhaps, the expression of an extremely strong sense of individuality which cannot bear the thought of living and dying like a man in the ranks, forgotten by coming generations? Is this ambition?

"The rattling of the guide-lines in the snow and the flapping of the sails are the only sounds heard, except the whining of the basket."

Misfortune dogged the Andrée expedition from the very start. The huge gas bag had been resting on Dane's Island for some weeks, awaiting favorable weather conditions. The balloon itself was sheltered by a great wooden wind break built around it. At three o'clock on the morning of July 11th, 1897, the water of Virgo Harbor, which had previously been as smooth as a mirror, was ruffled by the first cat's paw of wind from the South-Southwest. By four o'clock the wind had grown quite fresh, with now and then a squall, while the clouds moved northwards at a good rate.

Everything pointed to the south wind being steadier on this occasion than before, and that this supposition was general was confirmed by the fact that two Norwegian sealers put into Virgo, seeking shelter from the storm from the south.

Andrée was called early in the morning, and went out to examine conditions. After much deliberation and consultation with his companions, the start was decided upon, everything was packed up and placed in the balloon basket and the sailors from the Swedish Government tender *Svensksund*, which con-



Two of the three members of the expedition gazing ruefully at the remains of the balloon after it finally came to rest on the Polar ice. This is one of the many photographs taken by the explorers which survived 33 years of exposure to elements.

During their long trek across the ice the three explorers eked out their provisions as opportunity permitted by shooting polar bears. Andrée himself took this picture of his two companions examining a bear they had just shot.

veyed the expedition to Dane's Island, came ashore and proceeded to dismantle the balloon house. Finally, at 1.46 p.m., the balloon rose, slowly at first, and with rather erratic movements, to a height of 150-300 feet, and drove across Virgo Harbor, drawing after it the guide-lines which dragged over the water. Over the middle of the harbor the balloon began to sink lower and lower, until finally there was a sharp jerk which forced the basket partly under water.

The balloon immediately rebounded, while the aeronauts emptied eight bags of sand ballast (450 pounds). It was then that one of the sailors on the shore observed that the guide-ropes were lying on the beach. It appears that these lines were made up of lengths of rope, the ends of which were fitted with brass caps which screwed into one another, and the lower two-thirds of the lines had become unscrewed, due to kinking of the rope. The loss of these ropes meant that the ballast of the balloon had been still further diminished by 1,160 pounds.

The loss of the guide-lines caused the whole balloon journey to take place altogether in another way than had been intended, for the travelers now found themselves in an almost ordinary, free balloon, which would be compelled to obey the direction of the wind.

Sails, which were attached to the balloon, and which had been hoisted while in the balloon house, had now to be lowered quickly as otherwise, in the hard wind that prevailed, they would have prevented the balloon from turning right again.

Fraenkel was seen climbing into the balloon carrying-ring to clear the sails which were being lowered by Andrée and Strindberg.

A remarkable picture of one of the camps made by Andrée and his companions. Andrée is shown here standing on top of the balloon car, searching the horizon for signs of land.

The erratic course of the balloon, now entirely at the mercy of the wind, is illustrated in the accompanying official map. Two days after the start, on July 13th, the balloon began to sink and bump repeatedly on the ice, until finally, worn out and famished, Andrée and his companions landed on the ice at 7.30 a.m. on July 14th, 1897, having arrived at a point some 300 miles north-east of their starting point, and approximately 200 miles in a direct line from the nearest point of land at Spitzbergen.

Then commenced the terrible trek over the ice in an effort to get back to civilization. The landing seems to have been accomplished so successfully that no part of the equipment of the balloon car was damaged, and much of it, including a canvas boat, was loaded on to sledges which the three explorers commenced to drag across the ice.

The three men were surrounded by this chaos of ice, ice moving and drifting, pressing and screwing, sometimes breaking asunder into large leads, sometimes assembling into far-stretching masses. For hundreds of miles in each direction spread this scene. Such drift-ice, which is neither ice nor water but a mixture of both, is one of the most fearful expanses a man can ever traverse.

According to the charts Andrée had with him (which were found on White Island, last August), there lay at a distance of 192 miles from them, in a south-southwest direction, Northeast Land, belonging to the large Spitzbergen group of islands.

In a southeasterly direction, at a distance of 210 miles, was Franz Josef Land, where Fritjof Nansen spent the Winter of 1895-96 with his companion Johansen, and from which he returned to Norway as the world-renowned leader of the Fram Expedition.

On the English chart there was given "Gillis Land," which was nothing other than the Giles Land (White Island) named after the Dutchman Giles and which had been placed by the discoverer in an approximately correct position. The actual Giles Land, the now world-known White Island, was given as White Iceland.

No human being had hitherto visited the expanse lying between the Eagle's landing place and the groups of islands just mentioned. Andrée could, consequently, very well imagine the possibility of sighting some unknown land. Often we find him on the lookout for such a place.

The most important resolution made during the entire expedition had now to be taken—one of decisive importance for the fortunes of the three men.

They had to determine whether they should remain where they were, and drift with the ice, or begin a journey across it. In the latter case they had also to determine toward which land they should go. After some unwritten pages in his diary Andrée, on July 15, enters respecting this fateful deliberation merely the words, "determined to

This remarkable picture portrays Fraenkel (left), Andrée (right) and Strindberg pushing their heavily laden sledge across the snow and ice during the first part of their journey. The photograph is believed to have been taken by means of an automatic arrangement.

start from the point where we were."

Nothing is mentioned as to where they thought of directing their steps, but from the succeeding remarks in Andrée's diary it is possible to deduce that they had fixed on Franz Josef Land, and Strindberg in his shorthand notes for July 22 says that they are starting for Cape Flora in the archipelago in question.

The reason for this disastrous determination was, probably, first and foremost, that at the point mentioned there was a large depot for the expedition. In addition, Franz Josef Land, in consequence of Nansen's wintering there, was known by Andrée and his men to be a place where it was possible for human beings to endure the cold and darkness of the Polar Winter.

Finally, the island-group offered much of scientific interest, both of geographical, geological and other natural physical conditions. This latter fact was, most certainly, of no small weight when the expedition determined to direct its steps to Cape Flora. They did not know that their attempt to reach this goal would be prevented by an invincible ocean-current.

Now the three men learnt what it means to travel across the Polar ice. A little mishap occurred at the very start. When they were going to leave their ice-floe with their first sledge, this ran askew and slipped down into a pool of melted snow-water. Strindberg then stepped down into it up to his knees and held fast the sledge to prevent it sinking.

Andrée and Fraenkel went across to the other floe and they got the sledge up. Again they encountered leads, or channels, in which there float drifting ice-floes.

Not less than 10 channels had to be crossed during the first six hours. To complete their misfortunes, the snow was deep.

"Tramp on our knees in deep snow. Tramp, tramp on our knees. The discoverer of attractions of flopping—Nisse." (This is a reference to the many occasions upon which one or other of the party fell into the water.)

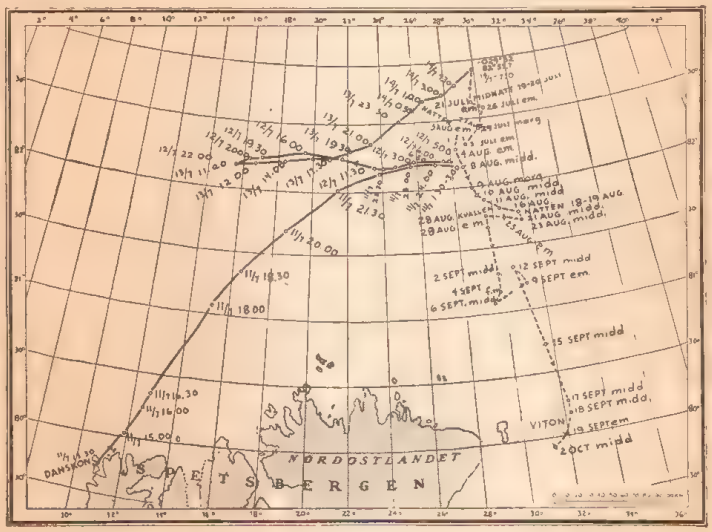
Thus writes Andrée of this march, which must, of course, have been tremendously fatiguing.

There were snow and open leads; also half-frozen, snow-covered, water-soaked portions of the ice were treacherous and placed hindrances in the way of the onward march toward their distant goal.

It was not until evening that they got clear of the hummock ice and came a good distance to the east. But their courage, good humor and vital will did not diminish.

This is the desolate scene of Andrée's last camp on White Island, where the remains of himself and his party were found by Dr. Gunnar Horn, who erected the cairn to mark the site. Members of the Hearst Expedition are seen searching for new relics among the snow.

"The polar district is certainly the birthplace of the principle of the greatest stumbling-blocks," writes Andrée.



The official map of Andrée's flight (heavy line) and subsequent wanderings (dotted line). Exact hours in Greenwich Mean Time are given in charting the balloon journey; only dates and period of the day are indicated along the route of the ice journey. Swedish abbreviations are translated in footnote.

Gradually, the party began to run short of provisions, and it became necessary to ration every man. After some days of restricted diet, there is a note made on August 8th.

At last, a little before midnight, they allow themselves a proper meal, with nine pounds of bear's meat and two pieces of bread per man, gruel made of Mellin's food, and biscuits.

Since the start toward Seven Islands the expedition had come thirty miles toward the south-southwest instead of southwest, although they had held the latter direction the whole time. It is also remarkable that during these last few days—between August 4th and 6th—they had been at about the same place where the balloon Eagle was between 1.30 and 3 o'clock on the morning of July 12th. And thus the terrible march continued.

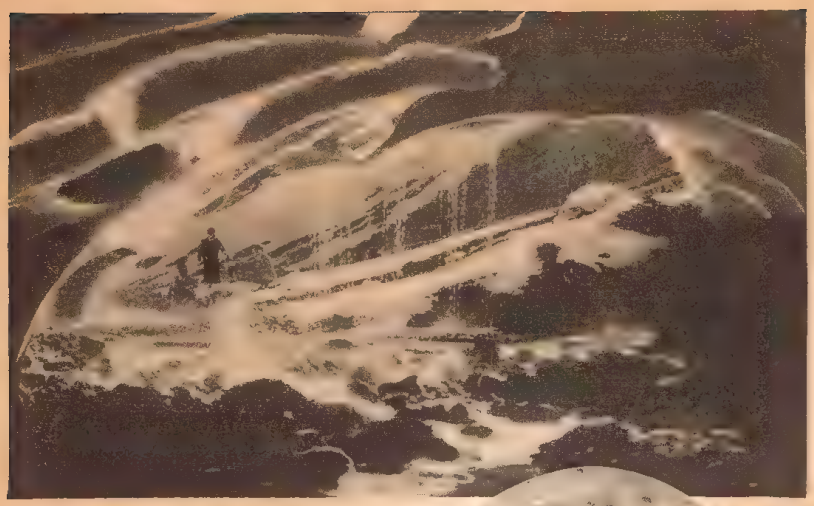
Bears were shot as occasion offered, thus eking out their scanty provisions. Weaker and weaker they grew as they battled their way over ice and water, with winter fast approaching. Finally, on October 2nd, 1897, they reached land — White Island, where they built a camp and made their last stand—a desperate and losing battle against starvation, cold, and exhaustion. Thus (*Continued on page* 1035)

The Swedish Government tender "Svenskund," bringing back from the Arctic the bodies of Andrée and his companions. It is a curious coincidence that this same vessel took the expedition to Spitzbergen for the start of the flight.

f.m. means a.m.; e.m. means p.m.; midd.—midday; midnatt—midnight; natten—night; morg.—morning; kvallen—evening; Spetsbergen—Spitzbergen; Nordostlandet—Northeast Land, a part of Spitzbergen.

Is the

By Orville H. Kneen



Luncheon in Nature's refrigerator. Looking from the interior of the blue-domed, crystal cave under Paradise Glacier, Mt. Rainier National Park, at Washington.

"FOR the year 2931—warmer and drier." This, in effect, is the prediction of our longest-range forecasters of the weather. To these glaciologists, students of the only accurate barometers of world climate, a thousand years is but a moment of geological time.

But as they measure hundreds of glaciers, and find them steadily retreating all over the world, the experts begin to agree on one important point—that we are now emerging from the ice age of some 12,000 years ago; and, barring accidents, for several thousand years our weather should grow warmer.

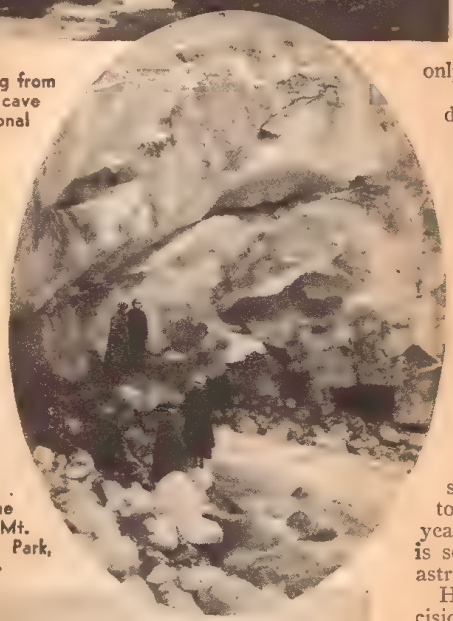
"There is good reason to believe," says Professor A. P. Coleman, of the University of Toronto, "that our present epoch is not really normal, but decidedly colder than usual, though much milder than in past ice ages. The paroxysms of cold must be looked upon as merely interludes between long periods of warmth."

At one time the earth's climate was so genial that even the Poles were free from ice. Temperate-climate vegetation once grew luxuriously even in northern Canada and Antarctica. The presence of coal and fossils in these places, and the absence of glacial action in large areas such as South America, prove that the entire earth was once free of ice. The snow that fell in winter melted each summer.

But at other periods much of Europe, as far south as London and Berlin, and most of North America, lay under solid ice. One Canadian sheet extended as far south as Burnett's Mound, in Kansas, where it left piles of gravel and huge polished quartzite boulders—native only to Canada and northern Minnesota. "These terrible catastrophes which half depopulated the globe," cannot occur for thousands of years to come, scientists believe. They are caused by rare combinations of atmospheric and geologic conditions, perhaps astronomic as well. A lowering of average temperatures of only 25 to 50 degrees would bring on an ice age. Volcanic dust, shifting of the poles, and other disturbances affecting our heat supply, affect our climate at times.

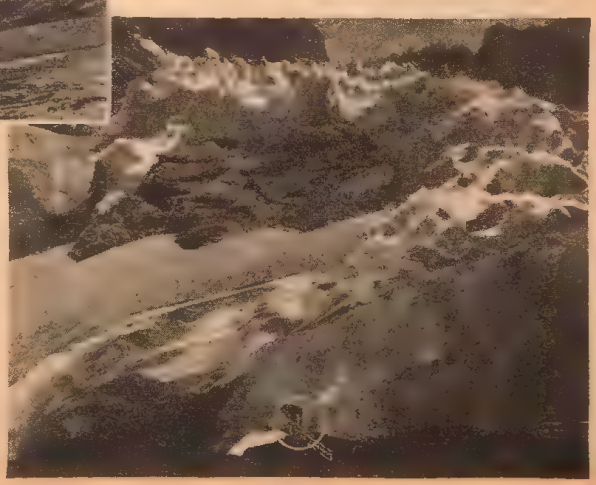
Professor P. L. Mercanton, noted glaciologist of the University of Lausanne, recently reported the continual retreat of Alpine glaciers. These have been accurately measured for fifty years. Four out of five are retreating, some are stationary, none are advancing to any extent. Snows for the past two years have been much lighter. Perhaps there is some connection between this and our disastrous droughts, floods and hot weather.

How do glaciologists measure with precision the complicated movements of glaciers? First their structure must be known. Glaciers of today, even those ten to sixteen miles long, as in Switzerland, are mere remnants of bygone ice sheets. They are formed when moisture-laden winds strike cold mountains,



At the foot of the Nisqually Glacier, Mt. Rainier National Park, Washington.

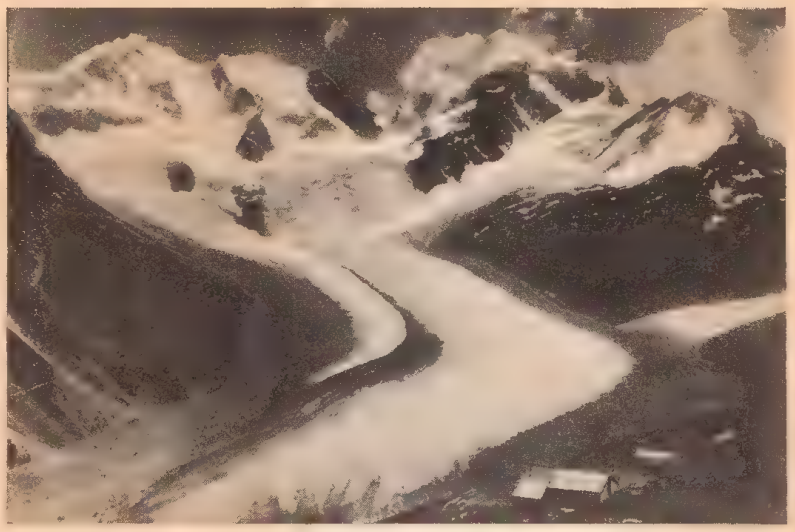
View from tongue of Freshfield Glacier, Canadian Rockies. The boulder, H, in contact with the ice in 1922, is now 330 feet distant. This explains the origin of isolated boulders which are found in various parts of the country. Note the distant wooded "dam" of old moraine across the valley.



Oberer Glacier, Grindelwald, Switzerland. The human being standing within the white circle by the hewn-out cave indicates height of the glacier's foot. Note how exposed rocks have been rounded off.

Earth Getting Warmer?

Twelve Thousand Years Ago Much of Europe and Most of North America Was Covered with Ice. This Ice Cap Has Gradually Receded Until Only the Polar Ice Caps and Glaciers Remain. Even These Glaciers Are Slowly Receding and Glaciologists Predict a Warmer Climate All Over the World



Tschierva Glacier, Swiss Alps. This picture shows how deep snow around mountain peaks slides downwards in a confused, tumbled mass, then congeals into solid ice which flows on down the valley like a frozen river. Note the banks of moraine which the glacier has built up for itself at its edges.

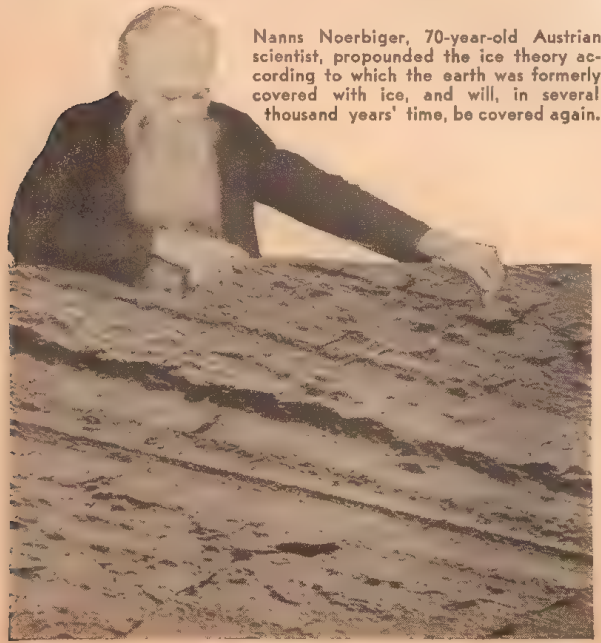
are forced up to high altitudes, and there release snow. This piles up, often to a depth of twenty and even fifty feet in a single winter.

The great pressure, and only partial melting each summer, results in a layer of pure ice. Succeeding layers, piling up in valleys and gulleys, high in the mountains, compress lower layers into "granular" ice, globules the size of hazel nuts, up to 1 and 2 inches in diameter.

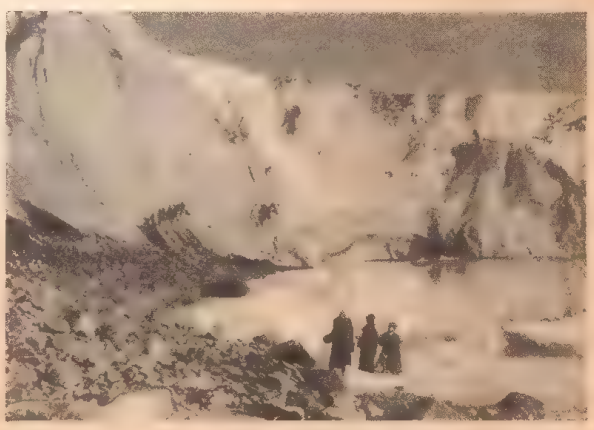
Such globules, all perfectly interlocked, occur in no other form of congealed water. The enormous weight of fifty, a hundred or several hundred feet of ice produces at intervals a temporary melting at slippage layers between globules, and the water so formed runs to points of less pressure. The effect of such slippages is that the whole weight moves forward and downward, due to the inexorable pull of gravity, and the glacier slowly crawls down its rocky bed, with groans and crackings and grindings, as quarried boulders are forced against solid rock. The ice next to the bed and sides moves slowest, because of friction.

Glaciologists often must climb for hours or days, packing their own provisions, perhaps braving storms and intense cold, to reach their open-air "laboratory." They measure general movement by various means. Two permanent points may be selected, on either side of a glacier, and a transit line run across the ice. Successive readings show clearly that the middle moves most rapidly. Early scientists had to work fast in drilling deep holes, to keep their tools from wedging in the hole. Today a hole 300 feet deep is drilled in a day. Echo sounding, in which the echo from an explosion is timed, measures depths accurately.

Special devices register on moving charts, something like seismographs, every time a granular slippage occurs. In 1922 J. Monroe Thorington, M.D., of the Smithsonian Institution, set a reference line (*Continued on page* 1042)



Nanns Noerbiger, 70-year-old Austrian scientist, propounded the ice theory according to which the earth was formerly covered with ice, and will, in several thousand years' time, be covered again.



Above—Where icebergs launch themselves into the sea in Magdalene Bay. The foot of the glacier, forced far out into the sea, breaks off under the influence of wind and tide to form giant icebergs. Left—Glacier markings on rock along Lincoln Pass, Montana. These markings can be seen in Central Park, New York, and in very many other parts of the country.

Fig. 1—A bullet roughly four inches out of the muzzle of a Colt .45 automatic. The puff of gas ahead of the bullet indicates a gas leak around the bullet before it left the muzzle. Note that the muzzle shows no sign yet of upward movement, due to "kick."

After the Shot Is Fired

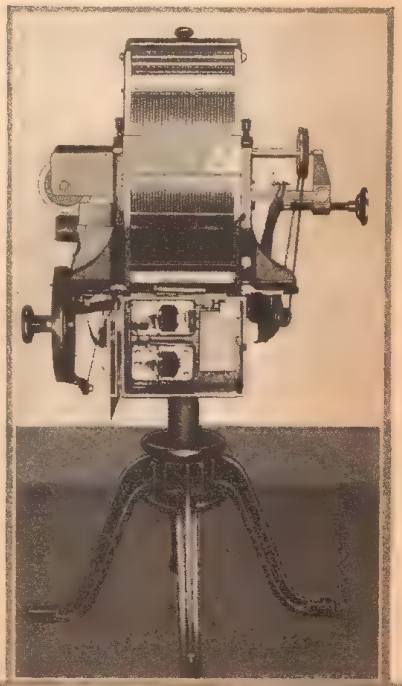
By Capt. Philip P. Quayle
The Peters Cartridge Company

AT that period in the history of the Imperial Army of France when it had behind it Marengo and Austerlitz and before it Jena, probably the Emperor Napoleon was eminently justified in considering it to be the finest body of troops of its day.

However, on the morning of the battle of Jena this great army was for a time forced to remain practically inactive, although often within pistol shot of the enemy, because of a heavy fog which covered the field.

So it is in many of the problems encountered in ballistics where the fog of tradition and inadequate facilities have long clouded the issue. Especially has progress been retarded towards a clearer understanding of the various factors which determine the accuracy and functioning of a given cartridge.

The cartridge manufacturer is confronted constantly with a great variety of problems in the solution of which mere visual observation is of little, if any, use. For instance, the firing of any cartridge takes place in so short a space of time that even with the slowest of lock mechanisms the entire time elapsing from the release of the firing mechanism to the emergence of the bullet at the muzzle of the arm is, in general, considerably less than ten one-thousandths of a second. Of this time interval usually three-fourths is used in the functioning of the firing mechanism and only one-fourth in the firing of the cartridge.



When it is considered that in moving pictures a frequency of sixteen cycles, or changes, per second appears continuous to the naked eye, it will be obvious that ballistic phenomena of the type we are considering cannot be adequately investigated without unusually complete laboratory facilities.

Realizing that in general it is neither efficient nor feasible to attempt to rectify a deficiency until the cause is understood, The Peters Cartridge Company has spared no expense in developing and installing the most unusual and complete equipment for ballistic research ever assembled in any laboratory.

One of the phenomenal features of this equipment is a highly specialized electric photographic apparatus in the physical laboratory which enables the company to obtain actual instantaneous records or photographs of any shell or cartridge in any stage of firing and to check its functioning accordingly.

A special high speed oscillograph camera equipped with a precision timing mechanism capable of measuring a second to one part (*Continued on page* 1043)

Top centre — The special high-speed oscillograph camera used to take the remarkable photographs reproduced on this page. Thus cartridge makers are enabled to determine accurately bullet velocities, primer ignition, and other necessary factors. Above, Fig. 2—This photograph shows the shot charge from a 12-gauge full choke shotgun, about 15 inches from the muzzle, and beginning to separate.

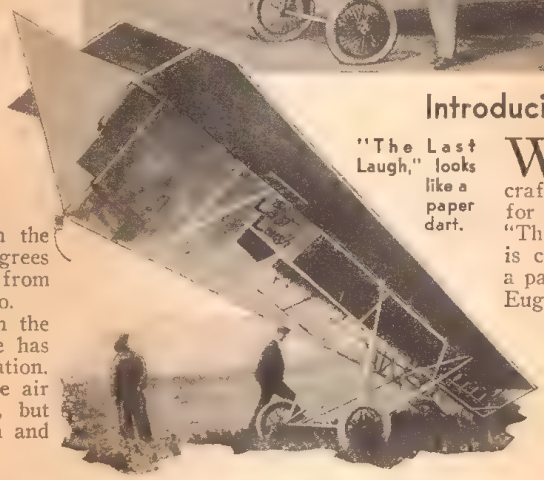
Above, Fig. 3—An unusual bullet, described in the text. Inset is the mark made by the bullet when it passed through a sheet of paper. Left, Fig. 4—A .30-06 metal case hollow point bullet roughly eight inches out from a paraffin cake. The bullet is just behind the V-shaped sound wave. The wax is thrown out from both sides of the cake, but the effect is of course greater on the emerging side.

Our Hot Earth Holds Icy Air Wells

JUST ask the folks in and around Snyder, Texas. Five years ago, while searching for oil, the drillers were met with a rush of compressed, frigid air, which shot forth from a well and continued to flow steadily. Subsequently another oil well in the same region spurted forth the same strange product—icy air.

A third remarkable well was recently brought to light when employees of the firm of Seifert, Dibble and Blackburn were testing for oil. Frigid compressed air was encountered at a depth of 1,171 feet. The flow will be harnessed to furnish power for boilers in near-by industrial plants, in lieu of steam, as well as for refrigerating vegetables and other food. In the hot summer, when the thermometer stood at 90 to 100 degrees Fahrenheit, the compressed air from the other two wells was below zero.

Geologists have speculated upon the cause of this phenomenon. None has furnished a satisfactory explanation. Originally it was believed that the air was non-inflammable helium gas, but tests proved it to be pure oxygen and nitrogen.



"The Last Laugh," looks like a paper dart.

Introducing "The Last Laugh"

WE wish Ray Scroggs the best of luck when he takes his strange craft, alongside of which we see him, for a sustained flight. He has named it "The Last Laugh." The plane, which is constructed on the general plan of a paper dart, has taken Mr. Scroggs, a Eugene, Oregon, tailor two years to build. It contains no wooden parts, and, except for the propellers, is made entirely of sheet metal and tubing. It has no wings of the common type. The designer claims that it is absolutely safe, and will not tail-spin, side-slip, or nose-dive. Maybe, maybe, and then again, perhaps.

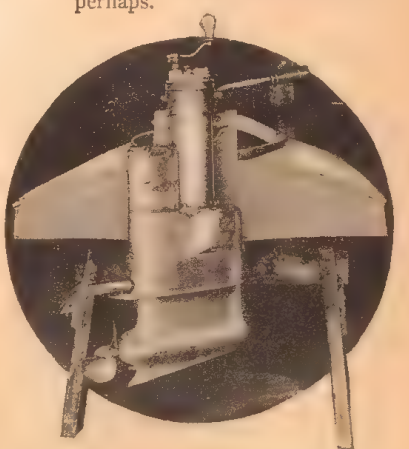
Double-Ended Wrecking and Fire-Fighting Truck

THE twenty-four million dollar International Tunnel connecting Detroit, Michigan, and Windsor, Ontario, the first international vehicular subway to be constructed, contains many unique features. It has a combination wrecker and fire-fighting dual control truck, pictured below, ready for action. This truck is equipped at both ends with winches, dollies and jacks for quick handling of motor vehicles wrecked within the tunnel. Complete fire-fighting apparatus, and materials necessary for the administration of first aid to the injured are also included.

Its four-wheel driving mechanisms permit steering through the wheels on either axle, thereby allowing either end of the truck to function at the forward end as the situation may demand. Two complete steering gears to control each set of wheels are arranged to work independently. Whichever set is the trailing one is locked rigidly in place. Although there are separate clutch, brake, and accelerating pedals, there is a common gear shift and emergency brake lever.

The motor used in this unit is capable of developing 76 b.h.p. at 2500 r.p.m., power sufficient to haul a load of fifteen tons up a 5.2 per cent gradient at the rate of four miles per hour. Its speed as a fire truck is between 20 and 25 m. p. h.

For a complete description of the tunnel, we refer you to the August, 1930, *Science and Invention*.

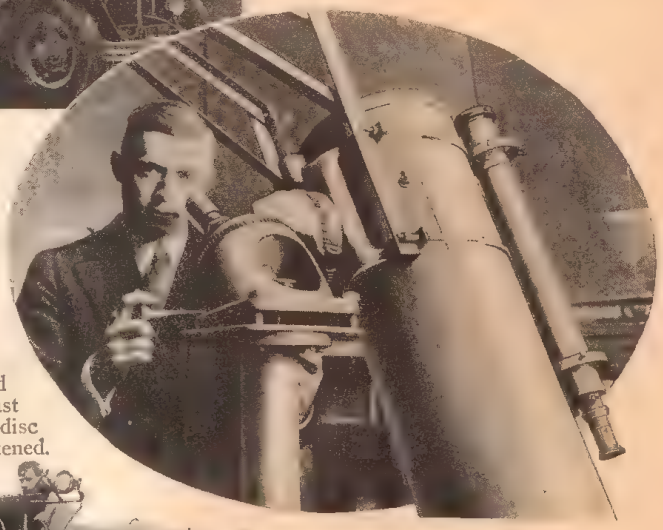


Outboard Runs Under Water

PERHAPS we can ascribe the versatility of the outboard motor to the fact that there are so many different varieties and makes. A western enthusiast has produced an engine whose cylinder and exhaust are both located under water. His boat is steered by turning both the engine and propeller, thus giving positive and instant control.

Plumber Builds Telescope and Observatory

WHEN the two hundred inch mirrored telescope which General Electric Company is building for the California Institute of Technology is completed, though it will be the largest one in the world, Leo J. Scanlon of Pittsburgh, Pa., will not be jealous. For this young amateur astronomer, with the aid of his friends, constructed a telescope at home. Most of its parts are fittings found in his plumbing shop. . . . And to house it adequately, an observatory has been erected in his back yard. Mr. Scanlon is shown with his telescope.



Mobile Mooring Mast

PORTABLE mooring masts have been added to the equipment of the airship ground crews at the Goodyear Tire & Rubber Company of Akron, Ohio. The "traveling harbor" is the co-invention of Chief Pilot Jack Boetner and Harry Haines of the Goodyear-Zeppelin Corporation. It consists of a tripod adjustable to a height of seven to ten feet which is mounted on the top of the ground crew bus. As the bus is 7½ feet high, the overall height of the complete apparatus can be varied between 14½ feet and 17½, according to conditions. At the top of the mast is a groove into which a locking device, built into a disc in the forward part of the ship, centers and is fastened. When not in use, the mast is folded and clamped down to the roof of the bus.

As the auto weighs three and one half tons, without a load, no fear is felt concerning its ability to hold the ship. When carrying its usual cargo of sand bags, tools and the baggage of the crew, the bus weighs approximately five tons. The mooring operation has several times been completed in less than one minute.

Always on the Level

THE driver of the truck pictured to the left doesn't care if the road is smooth as glass, or completely covered with rocks! For no matter what obstacles must be encountered, his six-wheeled truck will always remain on an even keel, at least so says the inventor. The car is so constructed that the wheels give in all directions. In this way the automobile is expected to maintain its equilibrium at all times. To prove to the skeptical public that everything's on the level, the driver deliberately drove his truck upon two blocks of stone. As you can see for yourself, the truck maintained a perfect level.

Combining All Musical Instruments

NEW YORK is eagerly awaiting the arrival of Maurice Martemot from France. This young man claims he will revolutionize modern music with his Martemot. It resembles the pianoforte in that it has a key board and a sound box. A complicated system of batteries and copper wire enables the player to duplicate the sound of almost every known musical instrument.

Is it the soothing tones of a cello you would like to hear? The shrill wail of a saxophone? The plaintive, poignant cry of the violin, or the rumbling roll of the organ? Monsieur Martemot is a very modest young man—all one must do is tell him the name of the musical instrument to be imitated, and he will get right to work on his Martemot.

Iron Yields Cotton

ACCORDING to Carlton Ellis, a New York chemical engineer, German research workers have perfected a process which yields material which closely resembles cotton. They manufacture it from the iron we use for constructing buildings. It is claimed that synthetic cotton looks and feels like natural cotton, except that it is blackish in color. Perhaps, if this defect is remedied, we'll soon be dressed in iron clothes.

Electric Surgical Knife

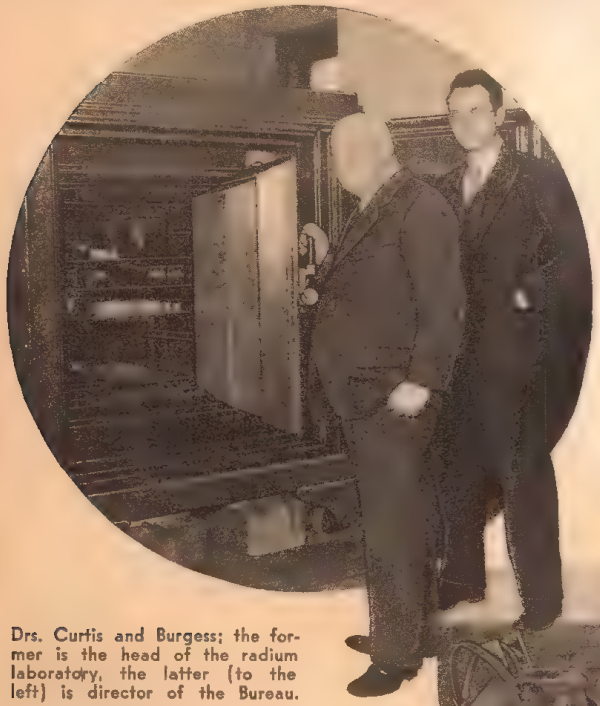
THE use of the electric knife in surgery was advocated enthusiastically by members of the staff of the American College of Surgeons. This instrument will permit surgeons to penetrate delicate parts of the brain into which they can not cut at present and will almost totally eliminate he danger of hemorrhage.

The instrument will prove particularly helpful in neurosurgery and the treatment of malignant diseases. It will allow the surgeon free play in disturbances which affect the spinal cord. And, while heretofore sixty or seventy silver clips were employed in even minor operations for sealing blood vessels, no clips are necessary with this knife when removing fair sized tumors and other growths.

This Safe Weighs Nine and One-half Tons

A POUND of radium equals 453½ grams. One gram is worth $75,000. How would you like to own the safe and the radium it contains when full? It is the strong box of the United States Bureau of Standards, and, at the time the photograph was taken, contained $455,000 worth of radium, all of which had been sent to the Bureau for testing.

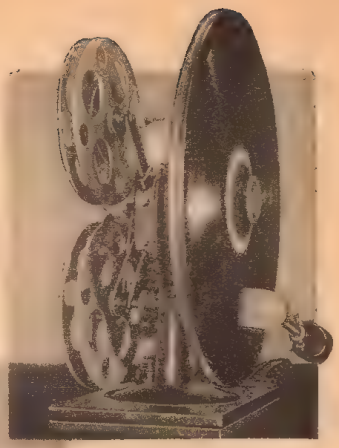
The safe was specially constructed for guarding samples of the precious element. It weighs nine and one-half tons, and has a six inches thick lead lining to safeguard persons working in the laboratory from being affected by radium emanations.. Of course the big box is well protected to guard its valuable contents against safe crackers.



Drs. Curtis and Burgess; the former is the head of the radium laboratory, the latter (to the left) is director of the Bureau.

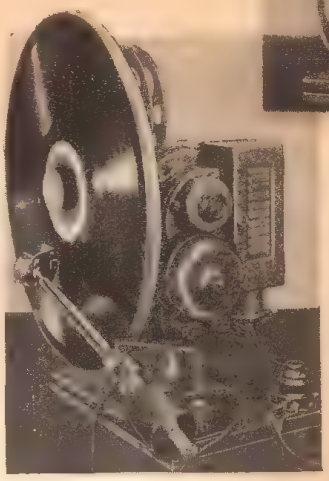
The Earth Has No Heart of Gold

THE core of the earth is metallic iron and nickel—not gold, as scientists have supposed. They believed that because of the globe's high specific gravity at the center, gold was a large constituent. Research work done by Dr. L. H. Adams of the Geophysical Laboratory of the Carnegie Institute proves fairly conclusively that gold is confined to the crust of the earth and the 4,000 mile diameter of our planet is metallic iron, plus nickel.



Rear view of the new talkie apparatus. Improved design prevents the transmission of extraneous sounds.

Front view of the equipment. Of special note is the animatophone in which the record is vertically placed.



Home Talkies' Projector

TALKING motion pictures are becoming more and more popular for business, church, school and even home performances. The Victor Animatograph Corporation of Davenport, Iowa, has just put on the market a 16 m/m sound projector, specially designed for amateur use. The Projector and Animatophone are not of the usual hook-up type, but assemble into a one unit, sound-on disc synchronizer. The projector can be used for silent operation without the animatophone, which can be attached quite simply, when desired. The even speed of the projector is controlled by an automatic air governor. By a small adjustment the machine can be set for the speed requirements of either 33 1/3 or 78 r.p.m. records. The instrument can be readily transferred from one locality to another as it operates on either AC or DC.

Listening In on Condenser Paper Imperfections

THE long strips of paper tissue that go into the making of a filter or by-pass condenser must be relatively free from metallic or foreign particles. To determine the cleanliness of the material, a listening in process has been developed by the Dubilier Condenser Corporation. The condenser tissue roll is placed in a device which comprises winding and unwinding rolls and contact members. An operator listens in by means of head phones to the clicks caused by metallic specks.

Above — The condenser tissue testing machine for detecting the number of conducting particles per unit area.
To the right—An operator testing condenser tissue.

Turning a Pistol Shot Into a Bombardment

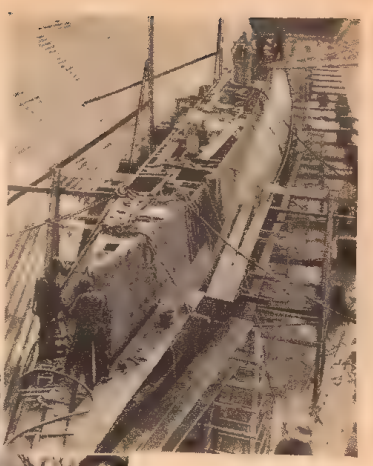
THOUGH producers stage effects for the talkies with a lavish hand, when it comes to turning loose a real heavy gun-fire bombardment for a moving picture, they call a halt. It's up to the sound engineers to evolve a realistic war scene; and the critical public is no longer content with the old methods of beating drums or rattling metal sheets.

Here's how a terrifying bombardment was achieved by firing a solitary revolver shot! Its detonation was recorded on film which was being exposed at the regulation speed of ninety feet per minute. Re-recordings of this film were made at several speeds, ranging from thirty to eighty feet per minute; the former sounded like a Big Bertha; the latter, like a three-pounder's bark. Selections from these were combined into loops of film of varying lengths and again recorded by three sound heads simultaneously.—*A. F. Birch.*

Sub to Go to North Pole

SIR WILKINS' submarine, the O-12 has been renamed the "Nautilus," and is being refitted for an expedition under the ice to the North Pole. The boat is in drydock at the Philadelphia Navy Yard at present. Sir Wilkins expects to start out within the year on the first trip by submarine to the Arctic regions ever attempted.

In the lower illustration we see Lieutenant Alfred Homann of Saint Rosa, California, at the steering wheel, mechanics are working on the inside of the submarine.



Braving the frozen north in this submarine . . that's Sir Hubert Wilkins' plan for the coming year.

Conductor J. A. Stevenson is a staunch advocate of the automatic street car announcer. His voice is getting a complete rest.

This is the inside of the Nautilus, in which Sir Wilkins' party will attempt the voyage. They are busy refitting the submarine at the Philadelphia Navy Yard.

This Automatic Announcer Tells You Where You Get Off . . .

REMEMBER back to the United States-Mexico oil controversy? You will readily recall the name Walter D. Hawk. Mr. Hawk, a Los Angeles attorney, was the internationally famous counsel for the Mexican Legal Commission which helped effect a settlement of grievances.

Blackstone's disciple is efficient at more than his legal practice . . . recently he took time off from his profession to make things a little easier for the hard working conductors, and, incidentally, proved his worth as an inventor. He has patented the first automatic street car announcer in the United States. Now it is being tried out under the direction of officials of the Pacific Electric Company.

Just imagine what a blessing this automatic device would prove on all our street cars. Instead of peering hopelessly out of the car window on a dark night to see where we should get off, or prancing up and down a crowded aisle to remind the conductor that we're still with him, we'd just up and go at our street corner.

Army Equips Six-Wheeled Armored Car with Wireless

IN the modern age of helicopter, autogiros, airplanes and dirigibles, the once novel automobile truck is apt to be overlooked. But not by the British. This new type of armored car has been adopted by their Tank Corps.

It has a six-wheel drive. In addition, two extra wheels have been fitted so that they can be brought into service when any of the other wheels break down when negotiating very rough country such as the Derbyshire Hills, in which this shot was taken. The armored tank has been equipped with wireless apparatus, so that in time of war, constant communication may be maintained with its base. There certainly wouldn't be much left of anything over which this car passed. This is not the only six wheel drive truck of note. A commercial model is described on another Spotlight page.

Processed Wood Doesn't Burn

A PROCESS of treating wood that may completely revolutionize fire insurance rates, thereby adding a tidy sum to Mr. Home Owner's savings yearly, has been perfected.

Everybody, it appears, was pleased by the results of tests held to determine the effectiveness of this fire-proofing method, in the experimental proving grounds of the Chesebro-Witman Company, Inc., of Long Island City, New York. Two miniature houses were constructed especially for the occasion. The one to the right of both pictures was built of lumber which had received no treatment. As can be seen from the lower illustration, it burnt to the ground. The house on the left had been constructed from specially prepared fire-safe lumber. It was merely damaged in appearance when the fire, which had been started from within, burned itself out.

The difference in the conditions of the two structures is noteworthy.

Vitamin-D Again

MOTHER can add two new fishes to her list of vitamin-D producing foods. They are the tuna and sardine, whose oils contain the antirachetic substance. These findings are considered also of interest to the poultry industry, which has made wide use of cod liver oil and ultra-violet rays for furnishing vitamin-D to the egg laying community. Here's an untapped source of vitamin-bearing fish oils.

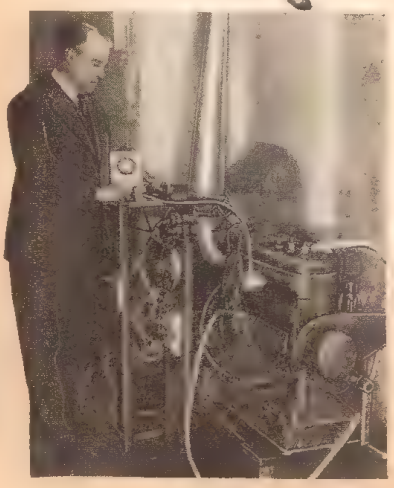
Paint Riot Gun

GERMAN policemen believe that good fortune, in the person of one of their countrymen, has sent them ideal equipment for dispersing unruly Reds—and perhaps some that aren't so unruly. The device resembles a fire extinguisher, but is filled with paint, which is squirted upon crowds.

Eliminating the Carbon-Monoxide Peril

"DEATH due to accidental asphyxiation from carbon-monoxide gas liberated by a running motor in a closed garage." How often have you read such an item in the newspaper?

Carbon-monoxide gas will be practically eliminated if the apparatus which Dr. Miller Reese Hutchison has invented, comes up to expectations. In the photograph we see the instrument attached to a motor. It is expected to increase airplane motor efficiency one third by registering imperfect carburetion; which, when corrected, will save the nation more than $1,000,000,000 annually through fuel conservation.



An Air-Minded Horse

ONE of the seventy thoroughbreds who will take part in the world's richest race, the $140,000 Agua Caliente Handicap on March 22nd, should go down in horse history. He is Bertrand. And here's why. His trainer, the famous "Boots" Durnell, used a Ryan monoplane to transport Bertrand from Tanforan to Agua Caliente.

We sincerely hope that making a pioneer of Bertrand has not made him swell headed, and that he'll not be soaring in the clouds at the races.

Two year old Bertrand in the Ryan monoplane, ready for his journey.

Bus Signal Indicates Passengers Are Alighting

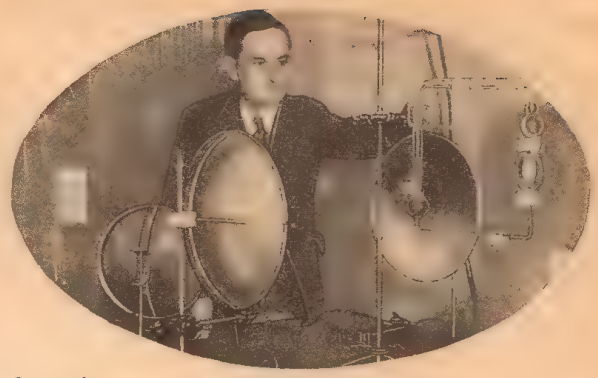
PROFESSOR GROVER VAN DUYN Superintendent of Schools at Greenfield, Indiana, has devised a means of setting Mother's mind at ease, while John and Mary are being transported to school by bus. It consists of a brightly colored enamel girl, 26 inches in height, which projects from the left rear end of the car when it stops. This

signal warns approaching motorists that the bus is taking on or discharging youngsters. When not in use, the doll can be folded back out of sight. A pull on a cord in the driver's seat propels the figure from its hidden compartment; another yank causes it to fold back. The inventor is pictured standing at the side of his device, which is already in use.

From Solar Energy to Water Power

SUNBURN isn't the only effect of King Sol. . . . Though we may consider it a far cry from solar energy to the water power which we use to turn the wheels of our industrial plants, the busy brained research workers of the Carnegie Institute at Washington, D. C., don't. They recently perfected apparatus for putting the sun's rays to good effect in industry. The photograph shows Dr. J. H. C. Smith, of Leland Stanford University, California, demonstrating the equipment, which was exhibited by the Division of Plant Biology, at the Institute's annual exhibition.

We wonder what will be the leading source of power a hundred years from today? Will it be energy collected from tides? From lightning? From the deep sea? Or from the sun?



T. H. Furman with his S.O.S. Signal, a colored balloon.

S. O. S. for Planes

LOST airplanes may fly their own S. O. S. signals, colored balloons, which automatically rise from the plane in case of a crash, and could be released by the pilot in case of an emergency landing. The device consists of a small box in the tail end of the fuselage, containing a brilliantly colored gas balloon. This is attached to a long, light wire. The box is opened by pulling a cord from the pilot's cockpit. When the captive signal balloon is released, it will rise and float above the wreck to mark the scene of the accident.

Germany to the Fore

SINCE the end of the World War, German scientists have been fighting to re-establish the right to call their beloved Vaterland "The Laboratory of the World."

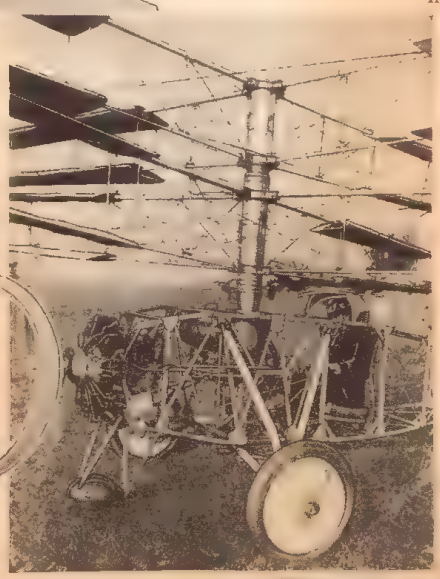
The work of Einstein alone would merit this title. Then we have Lacqueur and Windaus, two of the first experimenters with vitamins. Dr. Gearson, the German research worker, a short while ago discovered a cure for skin and bone tuberculosis — substituting mineral salts for sodium chlorite.

In the field of transportation, we have the huge dirigibles, such as the *Graf Zeppelin;* the steamship, *Europa,* which made the record-breaking crossing of the Atlantic. Who has not heard of the Flettner rudder for steering ships? And perhaps, someday Opel may still take a zoom to the moon in one of his rockets!

Radio Direction Finder

REGARDLESS of how far a pilot may stray from his course, it is Geoffrey G. Kruesi's plan to see that he gets safely back, without benefit of directional beam stations. All he need have as equipment to pilot him is this ten pound radio outfit. It is shown below, demonstrated by Mr. Kruesi, who is radio research engineer of the Western Air Express. The apparatus is expected to totally eliminate the necessity of the government's building directional beam stations equipped with powerful radio beacons. Reception of any broadcast is all that is needed.

The radio direction finder.

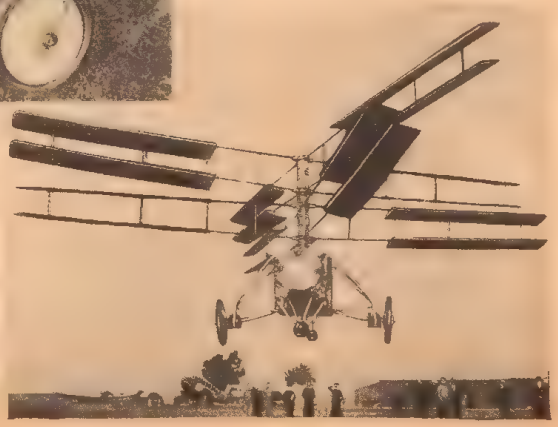


The Spanish Combination Plane, the Helicogyre

SPAIN'S contribution to aviation today is a combination helicopter and autogiro. As can be seen from the illustrations, it resembles a helicopter in that it has been constructed to ascend vertically into the air. Like the Cierva autogiro, it is lifted by four rotating wings that revolve about a vertical column above the fuselage, when the plane is in motion.

Raoul Pescara, the Spanish engineer who designed the craft, has successfully tested it. He asserts it can hover indefinitely.

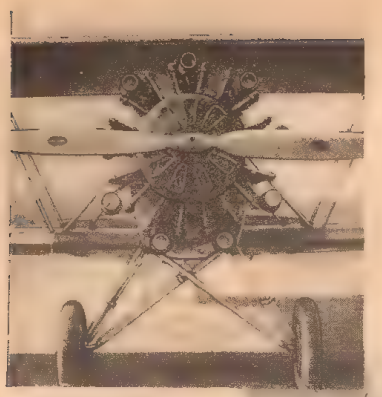
Senor Raoul Pescara in his Helicogyre, just before the take-off. Beneath this, the plane in flight.



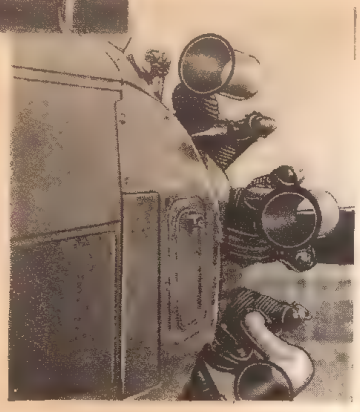
The large loop on the end of the rod is the aerial carried aloft; the other antenna is experimental and not necessary.

Airplane Engine Valves to Be Cooled by Venturi System

ONE of the great obstacles which airplane engine designers always encounter is the difficulty of cooling the motor. Considerable apparatus is incorporated into each power unit to prevent it from overheating. Obviously, the added weight of necessary castings and fittings is in no way desirable and reduces the load which the plane as a whole can carry. Any system which tends to provide a more efficient and lightweight means of cooling the engine is a long step forward. A San Diego, California, engineer who has been experimenting with airplane engine cooling systems believes that he has perfected one that is a decided improvement. It is based on the Venturi system of cooling. The air rushes into narrow cylinders as can be noted from the illustrations, expands on the way out, and, since expanding gases cool, cools the valves. Considerable weight is eliminated in engine fittings and the valves are satisfactorily cooled.



A front view of the narrow cylinders through which the air rushes. As the air expands, upon leaving the tubes, it cools the valves.



A close-up of the essential parts of the latest cooling system. From our photograph one can easily note the difference in size between the front and rear ends of the cylinders.

Heating Winnipeg by Electricity

WITHIN the next five years the City Fathers of Winnipeg, Canada, expect to free their city from all smoke and ashes, and also to cut down the heating bills of the residents. The contemplated construction of a city-owned hydroelectric plant is expected to give the desired results. Already a unit has been installed that heats 200 buildings and many homes. Central heating zones are planned to link the entire city. The adoption of the system would effect a drop of from 12 to 40 percent in the cost of heating homes, according to the head of the plant already in existence, besides eliminating the various nuisances attendant to heating with coal.

Re-enacting the Gold Rush of 1849

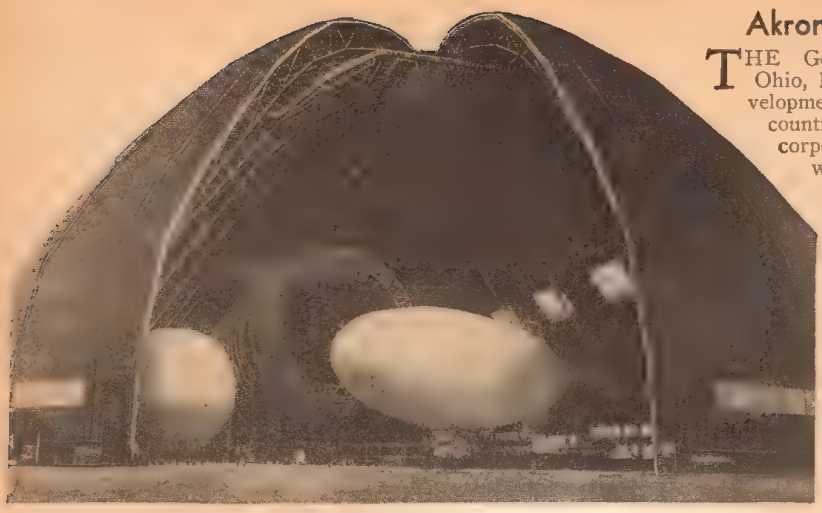
THE same air of excitement and expectation pervades the ice-bound fields of Elk Lake, Ontario, Canada, as did the sunny slopes of California, back in 1849, when the magic word, "GOLD," was flashed around the world. Just as at that time, men are now relinquishing their lifelong pursuits, selling their holdings, and setting out with their wives and children for this rude and primitive section of Canada, in quest of wealth. The same adventurous, gambling, feverish, courageous spirit distinguishes both groups of gold hunters; the only difference seems to lie in their methods of reaching the virgin country. Whereas, the forty-niners came in covered wagons, and astride horses, the families today arrive in Fords, equipped with trailers; airplanes are being used to transport mining equipment.

A few months ago the precious substance was found in the rocky formation of the ground, and hundreds are still flocking to the lode. Some of the gold seekers plan to remain over the winter, and are erecting rude houses for their families.

Nelson Cover of the Princeton crew, executing a back somersault. To the left—Cover making a perfect swan dive.

Learn to Dive Without Water

ONE of our earliest recollections of moving picture comedies was one in which the hero, a simple country lad, took a correspondence course in swimming, and was greatly shocked to discover that his success with the water compared to King Canute's. Now a system has been developed which will enable you to become proficient in diving without ever dipping into water. Princeton University has installed the equipment pictured, so that members of the Tiger's aquatic squad can practice for intercollegiate swimming meets without sustaining the tiring effect of water. Essentially it is a safety belt, which breaks the fall of the diver, who lands in a sawdust pit, instead of a pool. Outdoor winter practice is possible.



Akron—the Airship Factory

THE Goodyear-Zeppelin Company at Akron, Ohio, has steadily and surely sponsored the development of lighter-than-air craft in this country. Many of the devices which are incorporated in the huge dirigibles of today were conceived by their research engineers. The hangar at Akron is to be the birthplace of the *Akron*, the new craft being constructed for the United States Navy. When completed, it will be the largest airship in the world. Besides building such leviathans of the air, the Goodyear Company plans soon to put before the public small airships of family size.

In our illustration the three stages in the evolution of the airship, from its early form to its present state, are shown—a free balloon, a small, non-rigid airship, and the duralumin framework which will be the skeleton of the giant dirigible the *Akron*.

Improving X-Ray Technique

THE latest development in portable X-ray units is the Phillips Portable Metalix X-ray Machine to be used for making X-rays of patients unable to leave their beds. Another new device to combat disease is the new X-ray tube which photographs the arrangement of atoms in crystals. It enables one to take pictures in one minute that have heretofore required one hundred hours. X-ray photographs that formerly required about two hours to take, now can be snapped in but one-fiftieth of a second. Already these new diffraction pictures, which point out molecular structural changes between normal and cancerous bone, have been valuable in treating cancer patients. According to Professor George L. Clark of the University of Illinois, one of the tube's supporters, "It opens an almost unbelievably wide field in industrial development. For example, in studying how cellulose is made over synthetically into artificial silk, we formerly had to give an exposure of 100 hours, which only showed us the completed process, leaving us in ignorance of many of the intermediate steps that we needed to know most. This new tube has taken a diffraction picture of cellulose in one minute."

The usual bulky instruments have been replaced by these small units. The new X-ray in use at the bedside.

Otto Hofel of St. Louis, Missouri, finding out just what is wrong with an automobile engine sent in for repair.

The new gas mask permits one to phone comfortably while it is being worn. Colonel Charles R. Alley, of the Chemical Warfare Service, demonstrates this.

Diagnose Your Auto by Ex-Ray

IT may sound funny to you now, but before long, whenever your engine does not function smoothly, that will be the best thing to do. It will no longer be a tedious and troublesome job . . . just attach this central EX-ray and you'll immediately find the source of trouble in all or any of the parts, which are tested simultaneously. Instantly the supplementary dials indicate where the weak member is, and the extent of the damage.

We wonder just how expensive this machine is . . . perhaps those of us who are mechanically inclined could substantially reduce our garage bills by getting one, and acting as our own repair men.

Wear Gas Mask and Talk

THE wearer of the new gas mask, developed by the Chemical Warfare Division of the army, will be able to say just what he wants whenever he wishes. The mask is equipped with a diaphragm, permitting speech. Aside from its evident practicability for defeating poisonous gases, scouts or observers will be able to use it for reporting by wire to their bases.

During the World War, masked soldiers were compelled to communicate with each other by hand movements and like signals.

Outside the Earth

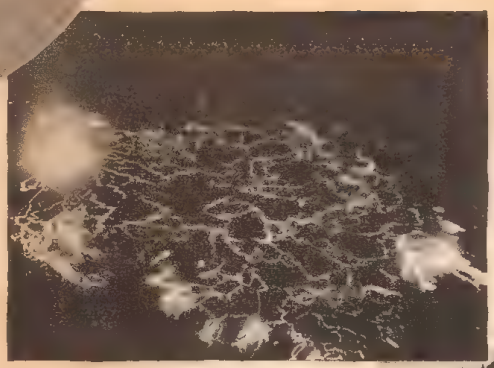
"IF there were any life on the stars where meteorites originated, the elements they contain would have been subject to the influence of oxygen, the presence of which is one of the main premises for life of any kind." So says Dr. George F. Kunz, who has just made a study of 850 meteorites. No trace of any fossil form or purpose of life on planets has been found. Furthermore, iron from two meteorites showed not the slightest evidence of oxidation; on the earth unoxidized iron is a rarity.

Would You Believe It?

The Pilot's Cross

WHEN a plane is flying high in the sky, with the sun directly overhead, and a bank of clouds underneath it, the craft's reflection will be mirrored against the clouds. As the plane's outline resembles a cross, this shadow is called the "Pilot's Cross."

Here is the "Pilot's Cross" caught by a cameraman over Miami, Florida. Note the surrounding rainbow halo.



Forty-five Acres of Fiery Lava

HALEMAUMA firepit was recently visited again by Madame Pele, the Hawaiian Goddess of Fire. Nine hours after the crater began to erupt, this shot was snapped from its southern rim. At the time, the lake of molten lava covered forty-five acres, two-thirds of the pit bottom: It is believed that a number of smaller, invisible fountains were erupting beneath the blackened top crust.

There's a Million Gallons of Water Underneath

THIS is a view of the top of the new underground lake, just completed at a cost of over $50,000 at Castle Donington, Leicestershire, England. It has been filled with a million gallons of water. The reservoir will solve for all time the greatest problem of the town—water shortage. During 1928, the drought became so acute that the population of 3,000 was forced to obtain water from a single spring.

Sailing in a Marble Boat

WE'D like to ask the residents of this summer palace at Peking, China, just what happens when their pleasure craft, made entirely of marble, unexpectedly meets another marble skiff. Save the pieces!

Just What Would You Do?

IF you were editing this magazine and a contributor sent you this illustration labeled a clipping from an early 19th century magazine, with "A rare photograph of the first train operated on the N. Y. Central Railroad. The historic DeWitt Clinton locomotive and train on the run from Albany to New York," would you believe him? Not if you remembered your history of printing. . . . This photograph could not possibly be authentic. The locomotive was built and put into operation in 1830. Not even the tintype was in use till after 1839. Then again, photo-engraving, or the transfer of photographs to the printed page, with shading and retouching, instead of mere lines such as line cuts or wood cuts employ, was not perfected till the 1890's—sixty years after the train was put into service.

So, strange as it may seem, the photo is a posed one, using a reconstructed model locomotive and coaches, with modern folk in the dress of 1830.

Have you any WOULD YOU BELIEVE IT photographs? We will pay five dollars for every photograph accepted and published on this page. Send them in to the Editor.

A modernistic whatnot like this is both useful and ornamental.

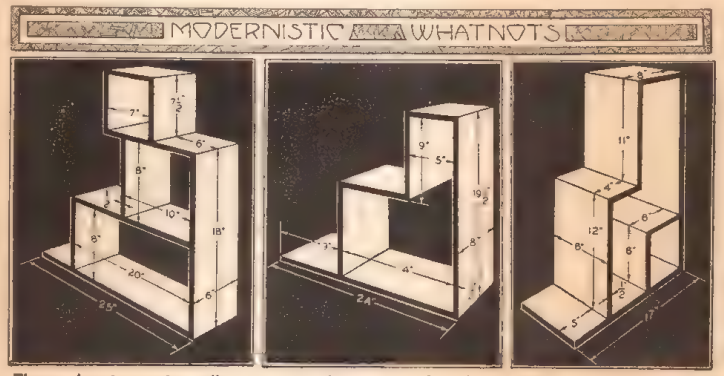
Building Modernistic Whatnots

By H. L. Weatherby

Director of Manual Training, Montgomery County Schools, Montgomery, Alabama.

WHAT is a whatnot? To give you the definition as found in Webster's Dictionary: "A whatnot is a small article of furniture, made up of open shelves, for the display of articles of elegance and use." Whatnots were very popular in our grandparents' day and earlier, and those of that period are classed among the treasured antiques and heirlooms to be found in antique shops and museums, and occasionally in the home. These whatnots were of varying height, usually so constructed that they occupied a corner of the room, and were made up of delicate turnings that separated the shelves.

Our modernistic whatnots are of entirely different design, but the definition holds equally as well for these as for the antiques.



These drawings give all necessary dimensions for the three styles of whatnots illustrated here. Many other designs can easily be evolved by the reader himself.

May Be Constructed from Scrap Lumber

Some weeks ago, the editor of SCIENCE AND INVENTION in a letter to me asked if I could not suggest some articles that could be made from packing cases and wooden boxes. The suggestion is a particularly good one to follow out at this time. The Government, through the Department of Commerce, is promoting just such a campaign and has issued a booklet entitled, "You Can Make It," containing drawings and descriptive material for the construction of more than two hundred articles of various kinds. For the benefit of our readers who may want this booklet, it can be had by writing to the United States Department of Commerce, National Committee on Wood Utilization, at Washington, D. C., and enclosing ten cents to pay for the cost of printing.

Government officials in a study of the waste occasioned through the discarding and burning of wooden boxes have estimated that the lumber so lost runs into the astounding total of several billion feet annually, or the amount of lumber used in these boxes each year would, if it were possible to convert them to house building purposes, be sufficient to construct 400,000 average size homes, or enough to shelter a population four times that of our Nation's capital. All of this being true, any use that we might make of such material means just so much of a saving of our national resources, besides the immediate saving to our private resources.

Painted furniture is very popular now, and here again our box wood can be used to advantage. It is true that a large part of the packing material is of an inferior or low grade of lumber, but by careful planing, sanding and filling of knot holes, plus a good job of painting, the results will be quite as satisfactory in the end as though expensive wood had been used. Wood that is used for boxes is usually soft and easily worked, and has the distinct advantage also in being well seasoned and dry.

Construction of Whatnot

Three different designs for whatnots are given, any one of which will give a modern up-to-date touch to the room in which it is used. Selecting the design is simply a matter of taste, since one is not any more difficult than another. Boxes not being available, any well seasoned lumber of about half an inch thickness and little grain will do. Where boxes are used, care must be taken in dismantling them so that the boards will not be split.

As to the actual construction of the pieces illustrated, there is nothing difficult about them. It is simply a question of getting all parts perfectly square, getting proportions right, and nailing them up carefully and square. They should be well prepared for finishing by sanding and filling of all knot holes and imperfections in the wood. Dents or mashed-in places are often found in the soft wood making up packing cases, due to the handling by shippers. Water on these spots will usually raise the wood to (*Continued on page* 1030)

Modernistic whatnots form a useful and attractive-looking resting place for books, vases and statuary.

A venetian worker putting a design on a leather pocketbook. Right—Toilet box of Maria Medici, Queen of France, made of maroquin with hand gold work; year 1620

Tools for Leathercraft Are Simple, Materials Are Easy to Procure, and Products of Work Have a High Useful and Decorative Value. Try It Yourself and See

Ewing Galloway, N. Y

Leathercraft—a Fascinating Hobby for the Amateur

By Murray Godwin

NOT a nation on earth, doubtless, but has its leathercraft, and its leathercraft products fashioned in its peculiarly national style. And what a range of uses, ornamental and utilitarian, those products cover! Whole volumes have been written on the drinking utensils of leather made in England alone. Bookbinding and upholstering are leather arts known to us all, but less familiar are the purposes which leather is made to serve by the Mexican Indians. These humble craftsmen apply leather to structural uses in chairs of their own unique design, having underpinning resembling an inverted basket; the leather is rudely tanned and really might be described as strips of hide.

Ancient craftsmen have left leatherwork of types almost unknown to us—groups of statuary, for example, moulded in leather over a plastic base. Leathern bottles are still in familiar use in many localities. Complicated pictorial designs in stained leather cutwork may be viewed in famous collections, such as the one in Berlin from which two illustrations have been taken for this article. Our own North American hunting Indians applied leather to housing; only the use of this flexible, light material made possible the easily portable tepee. It also formed, almost entirely, their clothing material.

The considerable interest in leathercraft, ancient and modern, naturally brings up the question of its possibilities for amateurs. It may be said at once that probably no craft offers such an easy start, or a more economical one. The simpler methods of leather working can be pursued with tools that are small, few, and easily improvised. The material is not too expensive for the worker of small income. The operations are interesting, offer an outlet for ingenuity in design and craftsmanship, and beget results which are useful and satisfying.

Good leather of almost any kind will serve as material for leathercraft. It should be chosen as nearly without blemishes as possible. Back leather generally is best and should be reserved for important work, while for minor jobs neck and side leather will do. The easiest way to obtain any desired leather for leathercraft work is to go to your neighborhood shoemaker and ask him to get it for you. He

(*Continued on page* 1055)

A tooled leather faced church door panel.

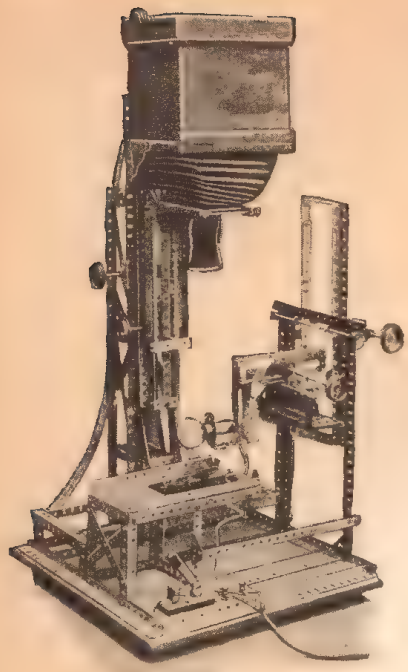
Bold designs such as that shown at left were commonly placed upon the doors of Austrian churches in the 18th century

Left—Among the many kinds of manufacturing and art work for which Venice is famous are leather handtooling and the making of purses. Here is a girl stitching sections of a pocketbook together.

Photographing Invisible Animals

Toy Constructor Parts Properly Assembled, Plus an Ordinary Microscope, Will Make It Possible for You to Photograph Minute Living Animals, Plants, and Insects

By Dr. E. Bade



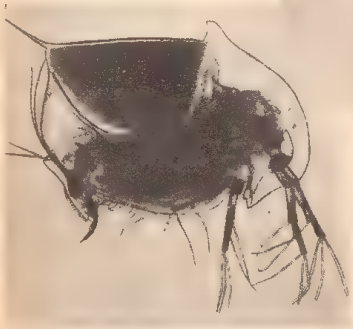
Here is the apparatus which will serve as your camera. The electric light, plainly visible, is either a 21 candle power or 45 candle power automobile lamp bulb.

THE elaborate preparation of microscopic slides of minute plants and animals for taking photographs is an unnecessary waste of time, especially if an upright microphotographic camera with an adjustable under-light is at hand. Placing the light directly below the stage of the microscope increases the illumination and gives better results than when the mirror with which the microscope is provided is used. With such a method of direct illumination even living plants and animals of microscopic size may be photographed almost instantly.

That this is a tremendous aid will be realized by all who have worked with infusoria, especially when trying to mount the ciliated animals and plants. Almost invariably the little whips will shrink, break off or be drawn within the body. But if the form to be photographed is alive, it will assume a natural position, all parts will be found in normal relation to each other, facts which are seldom the case with mounted specimens.

No lenses outside of the microscope itself are required for taking successful pictures. Microphotos are made by simply taking an old bellows from a camera, attaching it to a support to hold the camera above the microscope, the camera lens having been removed, and providing a light-tight cloth sleeve at this point, to be slipped over the eye piece of the microscope. Place a ground glass at the plate-holding end of the camera, focus by adjusting the barrel of the microscope as for visual observation, replace the ground glass with a photographic plate, expose, develop and fix the negative in the usual way.

So much for ordinary microphotos. For perfect results an adjustable light source below the microscope is essential, a light source which may be brought close to the condenser below the slide or at a variable distance from it, not exceeding six inches. It is this illumination from below with its variable distance from the condenser which permits perfect focusing and illumination of even the finest and minutest details. Ordinarily the light is quite close to the condenser and it is usually reflected into it by a mirror. This often over-illuminates the thin strands and threads, which results in photographs that give no idea of structure and lead to misleading impressions of the object taken.

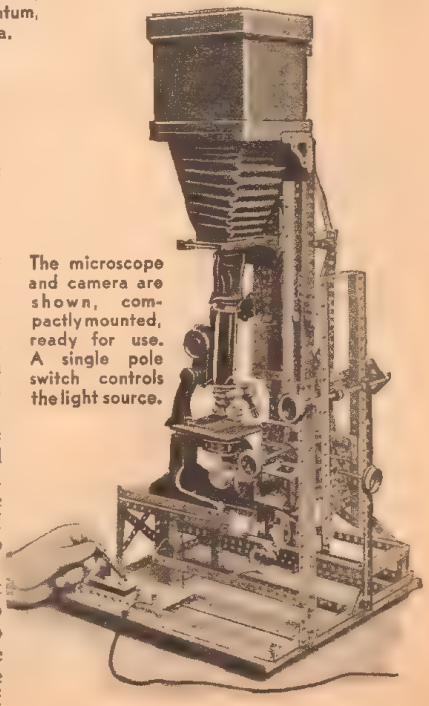


A few examples of animals and insects photographed with this equipment. From left to right—daphne pulex, ceratium corntum, and bosmia.

A microphotographic camera, with its light-source made variable for all purposes, can be easily constructed with wood, metal or toy construction parts such as are provided in Meccano sets. The first thing to do is to build the base platform upon which the camera and light source are erected. If the metal strips are used, build a metal square one foot to a side. On the center of one of the sides erect the upright which is to carry the camera bellows.

Since the camera is to be used at various extensions, a slide is added to the upright. It permits the upright to be raised or lowered according to the size of the picture to be taken. The sliding upright may be fastened, if wooden strips are used, by means of bolts and wing nuts. Better results are obtained by using toy-parts for rack-strips, and gears permit the instant raising and lowering of the camera, extending the upright to any distance desired.

The camera bellows is attached to this sliding arm, the upper part of which may be enlarged by wooden sides so as to take larger pictures. The lower (*Continued on page* 1053)



The microscope and camera are shown, compactly mounted, ready for use. A single pole switch controls the light source.

A Bottle Turns Instructor

These Interesting Experiments Illustrate the Principles Governing the Transmission of Pressure Through a Fluid

By Raymond B. Wailes

Set-up of a lung tester

ONE would not think that several hours of pleasure could be derived from an *empty* bottle, but with the aid of one or two short lengths of glass and rubber tubing, several corks, a medicine dropper or a pill bottle, a number of mystifying and instructive experiments can be performed.

A little girl or other figure that sinks into water and rises to the surface at the will of the operator is the subject of the first experiment. To make this amusing diving toy secure a celluloid doll. Weight it with BB shot through a small hole in the bottom so that the top of the figure is just above the surface of water contained in a half gallon fruit jar. The mouth of the jar is then closed tightly by stretching a sheet of thin rubber from (a toy balloon will do) across it and tying tightly. On pressing upon the flexible rubber top, the little girl or other figure will go to the bottom and will rise when the pressure is released.

The amount of water initially displaced by the figure is such that the figure just stays afloat. When pressure is applied to the water, the water rises up into the figure through the single hole in the bottom, thereby compressing the air inside the figure and displacing a volume of water which is equivalent to adding more shot and causing the figure to sink. Of course the figure must be at first adjusted finely with shot but this is not at all difficult.

The pill bottle will fall and rise at your command.

The BB shot weighted celluloid doll. A hole in the bottom allows the water to enter, as the pressure increases.

A cartesian diver, purchasable at any toy shop.

Two-in-line cartesian diver. Pressure exerted on either bottle will cause the dropper to sink.

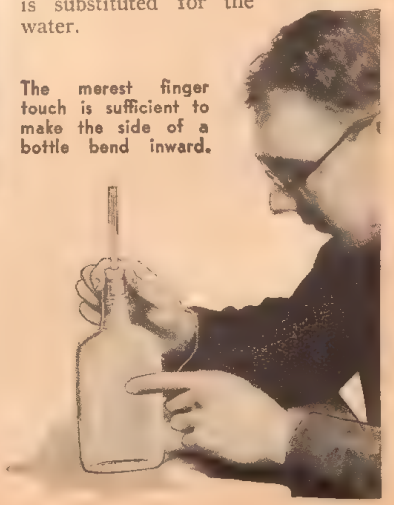
Several variations of the foregoing experiment are possible with a pint "hip" bottle and a medicine dropper. Fill the bottle with water and insert the medicine dropper, which will float. Insert a cork into the bottle. On forcibly pressing the cork in, the dropper will sink to the bottom and remain there if the pressure is not released. If the cork (and thus the pressure) is now released so that the dropper rises very slowly to the top and remains at the top, the bottle is ready for a very unbelievable experiment. One could never conceive that the glass sides of the bottle could be pushed or bent inwardly with the fingers without breaking the bottle, but such is the case. You can readily prove this by squeezing the flat sides of the bottle with the fingers. The dropper will then sink. The water which is not compressible can be seen to enter the medicine dropper as soon as the pressure is applied.

One may use a small test tube or a pill bottle in performing this experiment although it will have to be adjusted so that it barely floats inside the pint bottle. Filling it half full of water and air will be about right for a small vial. One can also blow a little ball or bulb upon the end of a short length of quarter inch diameter glass tubing and use it for the diver.

Two bottles may be connected with a bent glass tube and one bottle used as a pressure bottle and the other as the diving bottle. The stoppers must fit tight in this and also the other experiments.

A "lung tester" can also be rigged up by the simple process of passing a short length of glass tubing through the cork and blowing through a rubber tube connected to it. The pressure of the exhaled breath causes the diver to sink.

The sides or walls of some bottles can be pushed inward by the merest touch of the finger. To demonstrate this, pass a capillary or small bore glass tube through the cork and have the bottle filled entirely with water and the glass tube partially. On touching the wall of the bottle with the finger, the glass will bend inward, and as the water within cannot be compressed, it will rise upward into the glass small bore tube. This movement can be more easily seen if a colored ink or dye is substituted for the water.



The merest finger touch is sufficient to make the side of a bottle bend inward.

Facts That Amaze

When Is Work Not Work? By Stroking a Cat's Back You Can Develop a Potential of Several Thousand Volts—Why Isn't It Dangerous? Can You Make a Free Toy Balloon Follow You? Why Does Your Weight Increase as You Descend a Mine, Yet You Weigh Nothing at the Earth's Center?

By Ernest K. Chapin

This man is not working!

MANY folks have learned to respect or even fear the 110 volt power lines that enter the house. Fingers have been burnt, severe shocks have been sustained, and even lives have been lost due to the action of this comparatively low voltage. Yet, under proper conditions it is possible to draw a spark about a twentieth of an inch long by bringing a knuckle near pussy's nose after her back has been stroked.

If the tips of two wires are placed this distance apart it is found that a voltage of about 4,000 volts is required to produce the first spark So the electrical potential on the cat's back must be at least several thousand volts. From this fact one might consider the petting of a cat as a major electrical hazard.

If voltage were the only consideration, the act of stroking a cat's back would be fatal to both parties. That there are no serious consequences is due principally to three facts. First, the spark that jumps between your knuckle and the cat's nose probably doesn't last a millionth of a second. In the next place, the voltage of 4000 volts drops almost to zero as soon as the spark begins. And third, the resistance that the charges encounter from one body to the other is so great that the current is very slight indeed. After all it is the current rather than the voltage that causes any serious consequences from an electrical discharge.

For some reason not yet wholly explained,

4000 volts! Yet both man and cat are unharmed.

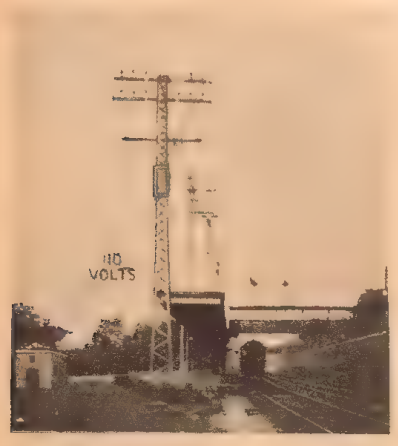
the atmosphere is usually charged positively with respect to the earth. The electrical potential rises with increasing elevations at a rate of from 30 to 50 volts per foot. It is seldom less than 110 volts for six feet, though at times the charge may be less or even reversed. A person standing on the ground is not injured by this voltage because his contact with the ground brings his whole body and that of the surrounding air to practically the same potential as that of the earth. Even if a current does flow to and through his body, it is so slight as to be unnoticeable except in extreme atmospheric conditions such as may prevail during a thunderstorm.

This is a very simple trick, but one that does not seem to be generally known. Stroke an inflated rubber balloon with a silk handkerchief. A charge is thus transferred to its surface. As the charges on the balloon are attracted by neutral bodies, the balloon will readily approach the hand extended toward it and may even follow a person around a room until the charge is lost to the air.

Nearly every year witnesses the development of some new and highly sensitive device. Great telescopes gather light from invisible stars and record their presence on a photographic plate. By use of mirrors the radiated heat from a man a mile away can be concentrated at night on a sensitive thermopile with observable effect. Photoelectric cells can be used to detect extremely minute differences in shade. With all of these devices every effort is made to gather in a large amount of light to the receiving instrument.

Now consider the human eye. Suppose it to be looking at the faintest visible star, a star of the sixth magnitude. No telescopes, no reflecting mirrors, just an opening a quarter of an inch in diameter through which all of the received light must enter. Someone has estimated that under these conditions about 0.000,000,01 ergs of light energy enter the pupil per second. At this rate a person would have to look at the star for nearly three and a half billions years to get enough light to warm an ounce of water one degree. The photographic film at the focus of a great telescope may take minutes and even hours to register the light from some of the stars; but the eye, if it can see it at all, will detect the light almost instantly.

When you (*Continued on page* 1056)



Between the earth and the air six feet above it there is a difference in potential which may equal or even exceed that between the wires of a 110-volt circuit.

By properly charging a toy balloon electrostatically you can make it approach your extended arm.

Make This Home Recording Outfit

Snap the switch and your voice engraves its own lasting record.

How to Build an Electric Phonograph Recorder With Full Instructions for Adapting It to Your Radio Set to Take Advantage of the Amplifying System

By Randolph Jones

MOST radio experimenters probably have an electric phonograph pick-up handy, or can procure one at bargain prices now being quoted by radio shops most everywhere. Here is what you will need in order to make your own recordings of either radio or microphone voice currents:

Have an electric phonograph pick-up, some pre-grooved record blanks such as are now sold in all phonograph stores, some of the new special recording and reproducing needles, a phonograph or at least a spring or electric motor and turntable to revolve the records, and either a radio receiving set or a two-stage amplifier, and a microphone.

In using the electric pick-up as an electric *recording* device for engraving the various curves representing the voice or music on the V-shaped grooves in the record blank, an extra weight of from eight to fifteen ounces is usually found necessary, placing this weight on the pick-up or on the end of the arm supporting the pick-up, and in close proximity to it. In Fig. 1 there is illustrated a home-made double pivoted arm to be used for supporting the magnetic pick-up. This arm is supplied with two sliding weights, each provided with a lock screw. As will be seen from the drawing, this arm provides sidewise, as well as up and down motion. The regular tone arm on your phonograph may be used and at least one of the electric pick-ups fits on to the end of the tone arm in place of the usual sound-box, the one referred to being the "Gradeon."

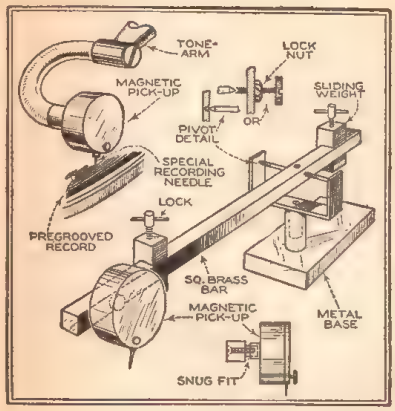


Fig. 1—How the magnetic pickup is supported.

In Fig. 2 several interesting angles of "home recording" are portrayed. At "A" is shown one experimental way of recording radio music by placing the loud speaker (or a person may speak into the horn) in close proximity to the opening of the phonograph horn. The sound waves pass up through the horn and vibrate the diaphragm of the regular sound-box or reproducer, into which is secured one of the new *recording* needles. A pre-grooved record blank, such as the Victor, is placed on the turn-table and you are ready to start recording. If a loud speaker unit of small size is to be employed it may be mounted on a piece of wood with a hole in its center, the wood support for the unit being placed up inside the horn, with some felt around the edge of it. An interesting method for recording is that shown at "B" in Fig. 2. A loud speaker unit is fastened by tape or mechanical means to the end of a tone arm and to the front or cap of the unit is taped or otherwise secured a phonographic sound-box. The incoming radio or microphone currents actuate the diaphragm of the loud speaker unit and the sound waves set up are transmitted to the diaphragm of the sound-box, thus vibrating the needle arm. Of course, one uses a special *recording* needle in the chuck on the sound box.

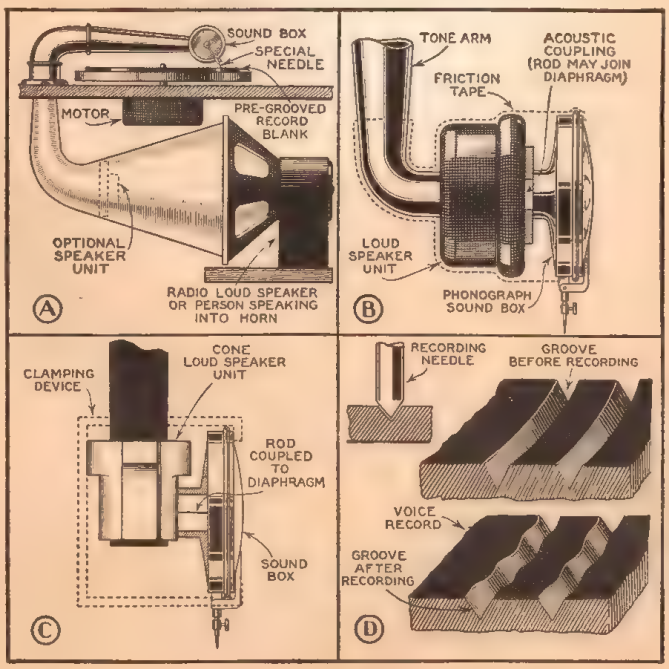


Fig. 2—Several methods of home recording.

Still another experimental recorder comprises a cone speaker unit, mechanically connected to the diaphragm of a phonograph reproducer or sound-box as shown at "C."

The illustration "D" shows how the recording needle is moved from side to side in the V-groove and leaves a characteristic undulating voice record as illustrated.

Complete circuit connections through a two-stage amplifier such as is shown in Fig. 3 is found in the average radio set. Here a magnetic pick-up is shown resting on a record and the currents generated by the pick-up are passed through a potentiometer and then into

(*Continued on page* 1036)

What to Look for When Buying a Used Car

By Arthur George
Consulting Engineer

WHEN a used car is sold "As Is," the prospective purchaser must rely upon inspection and tests to determine whether or not the car is a good buy. The *Used Car Book* value should also be looked up. In most cases it is below the selling price; if equal to the selling price, you may usually suspect that there is something wrong with the car.

Proceed to inspect your used car as follows:

Engine for compression, exhaust smoke and loose bearings: drive the car up a fairly steep hill and listen for knocks.

Transmission: try in reverse and the three forward speeds, watching for unusual grindings or jerky noises.

Clutch: stop and start the car up a steep incline; the clutch should not slip.

Steering gear: note if any objectionable lost motion exists.

Radiator: run engine until hot and note if hill-climbing makes the radiator boil.

Battery: inspect top of battery and terminals to see if they are corroded from leaking cells, and try connections to see if they have been eaten by acid.

Tires and rims: determine if these are of standard size and can be replaced. If the car is in good general condition in regard to these items, it is a fairly safe purchase.

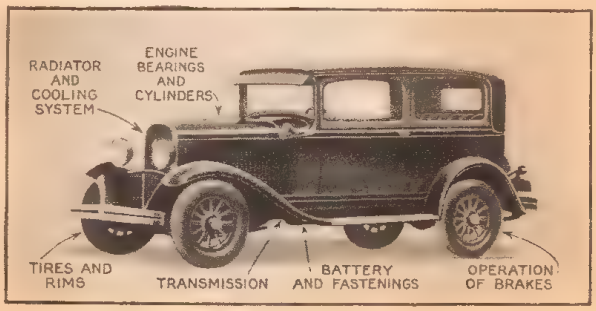
After you have purchased a car, you must accord it good care for smooth operation. If you heed advance notices of trouble, you will be well rewarded by the way your car responds. Here are a few everyday examples of warnings that should not pass unheeded.

When the car fails to start on some rainy morning, the raising of the hood may make conditions worse. The water may pour down through the hinge, right on the distributor. And the sudden stopping of the engine when driving fast on rough, weather-beaten roads may be due to the high tension wire being shaken out of the distributor head. Then too, if battery clamps are not tight the connections may loosen or break.

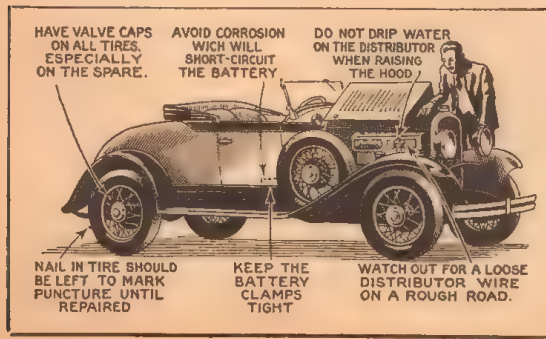
It is not always advisable to pull out a nail from a tire immediately; leave it to mark the position of the hole until such time as the tire is repaired. But watch the tire. If it starts to leak draw out the nail so that it will not puncture the tube in another place. The excess accumulation of corrosive material on the battery may be the unsuspected cause of a discharged battery. Water thrown up by the car wheels and collected by these deposits on the battery, aggravates the situation.

Several days ago, a nearby motorist had to make a tire change. In doing so the valve tip in the spare struck the wheel rim, starting an unobserved leak. By the time the change was made the tire was practically flat. A valve cap on the stem would have prevented this.

When the engine begins to get noisy and oil passes the pistons fouling plugs, and giving off a smoky exhaust, it is a sure sign that the pistons are worn and the rings may require renewal. In fitting pistons, it is usual to decide upon oversize parts, these being in some instances .002 of an inch larger than the standard. Pistons are necessarily smaller than the cylinder; however, iron pistons require less than half the clearance of aluminum alloy. In no case should tight pistons be fitted, as the expansion by heat requires a certain initial clearance. A safe rule for piston clearance is to allow for each inch of diameter of the piston .001 of an inch for (*Continued on page* 1027)

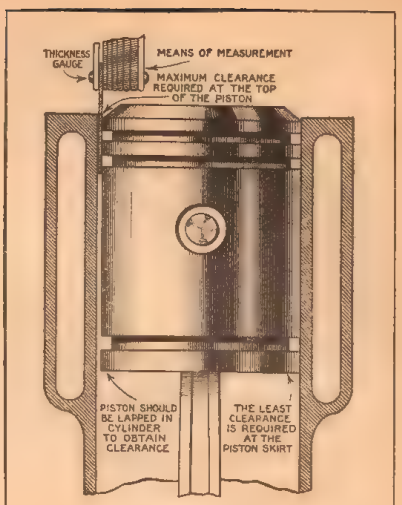


In selecting a used car, there are several points which should be inspected. The most important ones are indicated here.


HAVE VALVE CAPS ON ALL TIRES, ESPECIALLY ON THE SPARE.
AVOID CORROSION WICH WILL SHORT-CIRCUIT THE BATTERY
DO NOT DRIP WATER ON THE DISTRIBUTOR WHEN RAISING THE HOOD
NAIL IN TIRE SHOULD BE LEFT TO MARK PUNCTURE UNTIL REPAIRED
KEEP THE BATTERY CLAMPS TIGHT
WATCH OUT FOR A LOOSE DISTRIBUTOR WIRE ON A ROUGH ROAD.

Preventing Road Troubles

HAVING purchased a car, used or new, you naturally want it to remain in good condition as long as possible. Quite often, by heeding advance notices of trouble, you can save yourself time and expense, and add to the life of your car.


THICKNESS GAUGE
MEANS OF MEASUREMENT
MAXIMUM CLEARANCE REQUIRED AT THE TOP OF THE PISTON
PISTON SHOULD BE LAPPED IN CYLINDER TO OBTAIN CLEARANCE
THE LEAST CLEARANCE IS REQUIRED AT THE PISTON SKIRT

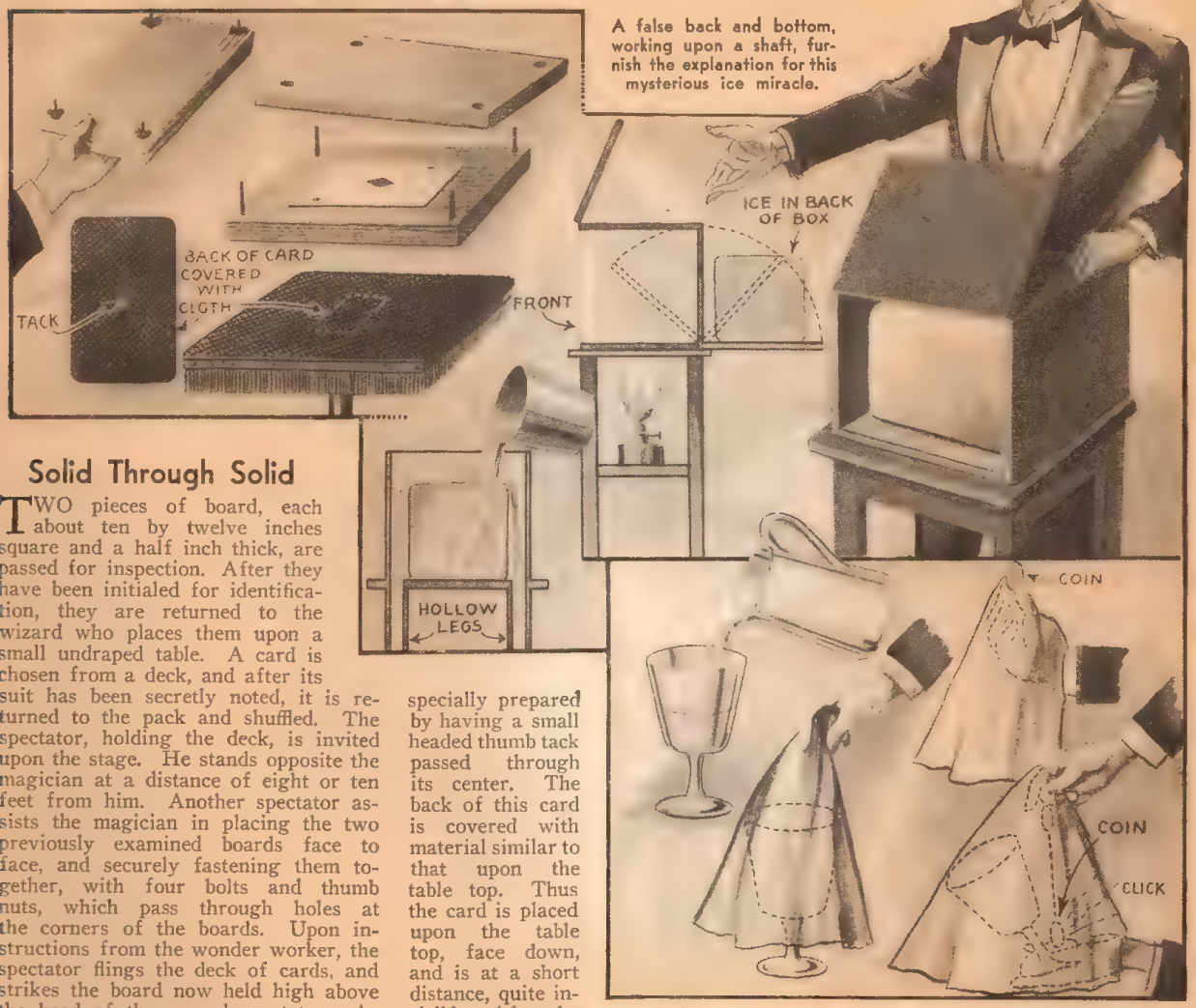
Clearance for Pistons

A NOISY, smoky engine and leaky pistons usually means that the pistons are worn out and should be replaced. In fitting them, remember that allowance must be made for heat expansion, and that as the head in each case is the hottest part, it therefore requires slightly more clearance than its skirt. Allowance for each inch of diameter of the piston should be .001 of an inch for cast iron and .002 of an inch for aluminum alloy.

MAGIC

By Thurninger*

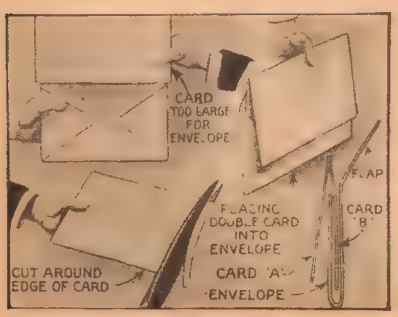
The master mind of modern mystery, who has mystified Ex-presidents Harding, Taft, Roosevelt, Coolidge, the Prince of Wales and other celebrities, presents another of his magic series.



Solid Through Solid

TWO pieces of board, each about ten by twelve inches square and a half inch thick, are passed for inspection. After they have been initialed for identification, they are returned to the wizard who places them upon a small undraped table. A card is chosen from a deck, and after its suit has been secretly noted, it is returned to the pack and shuffled. The spectator, holding the deck, is invited upon the stage. He stands opposite the magician at a distance of eight or ten feet from him. Another spectator assists the magician in placing the two previously examined boards face to face, and securely fastening them together, with four bolts and thumb nuts, which pass through holes at the corners of the boards. Upon instructions from the wonder worker, the spectator flings the deck of cards, and strikes the board now held high above the head of the second spectator. As the boards are unbolted, the selected card is found to have mysteriously made its way in between the two sections of wood.

The card discovered between the boards is a duplicate of the one which was originally selected. The selection, of course, is forced. This card is specially prepared by having a small headed thumb tack passed through its center. The back of this card is covered with material similar to that upon the table top. Thus the card is placed upon the table top, face down, and is at a short distance, quite invisible. After the boards have been examined and marked, they are placed upon the table, and the thumb tack is secretly driven into one of them, so that the card is attached face outwards. After a bit of manipulation, the sides of the boards are shown, save for the one to which the card is affixed. They are bolted together, and the wizard is all set to proceed.



Invisible Fingers

THE magician shows a large, blank card, which, after being initialed, he attempts to slip into an envelope. Discovering that the card is a trifle too large for the envelope, he trims the edges and puts it into the envelope, which he then seals. Holding the envelope in his outstretched hand, he commands the invisible fingers to write. Upon again opening the envelope, the card is removed, and a spook message is found written boldly across the surface of the initialed card.

The apparently single card was really two cards, carefully glued together around the edge. As the writing is in between, it is invisible. The card is larger than the envelope so that one may cut the pasted edges, thereby separating the two cards. In the act of sliding the card into the envelope, the blank card is slid outside the envelope and concealed in back of it. The envelope is sealed, it is opened, after some mysterious byplay, and the message-bearing card removed. The concealed card is disposed of, with the enevlope.

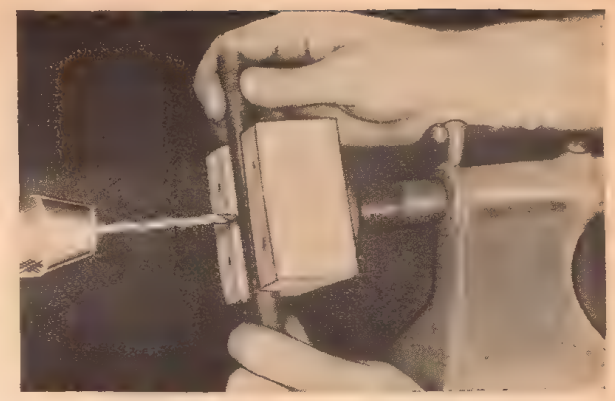
The card pasted over the one upon which the writing appears should be of far lighter weight than the latter. Thus, the spectator, who has marked the card for identification, will not be able to (*Continued on page* 1025)

No. 90 of a series of articles on magic appearing monthly.

Metal Turning on a Wood Lathe

Most of the Shaping and Finishing Operations to Which You Subject Wood Can Be Duplicated in Working with Metals on Your Lathe. No Special Attachments Are Necessary

By S. Robert Gordon

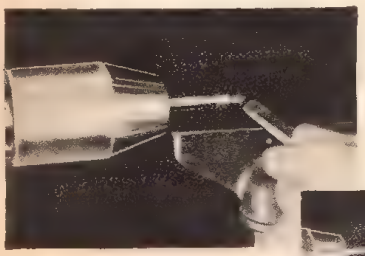


For drilling, hold round stock in a V-block.

THE wood turning lathe is truly the heart of the home craftsman's motorized workshop, for with it, one may grind, buff, turn, saw, drill, scratch brush, and sand. One of the least things a wood turning lathe could be expected to do is that of turning metals. But such an operation is entirely feasible on the lathe. Small parts, like pendants, binding posts, and brass dummy whistles for toy locomotives, can be turned on such a lathe.

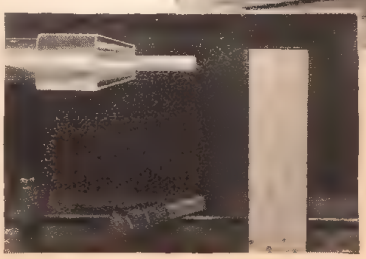
For turning soft metals such as brass, in the lathe, one may fit the work into the chuck and use some appropriate turning tool in the hands as one turns wood, using a slower lathe speed. With only an ordinary quarter inch cold chisel, held in the hands and rested on the tool rest, the writer satisfactorily turned a small missing machine part on the wood turning lathe. Even a file held against the turning work will take off a cut which can be smoothed with emery cloth.

Cutting metal pipe, tool steel, bar stock, etc, with a spinning wheel on the wood turning lathe is being done in industry today, and for the home shop worker there is offered a metal cutting wheel a sixteenth of an inch thick composed of bakelite and carborundum which will be found to be a welcome addition to the shop. One may cut through a piece of gas pipe almost like cheese, using this metal cutting disc, fitted on the headstock spindle. By holding the end of a short length of gas pipe against such a spinning metal-cutting wheel one may cut out teeth-like projections on the end of the pipe which will prove highly suited for drilling in brick and other walls in the absence of a star drill. In cutting, the wheel does not leave burrs on metals as does the hack saw.



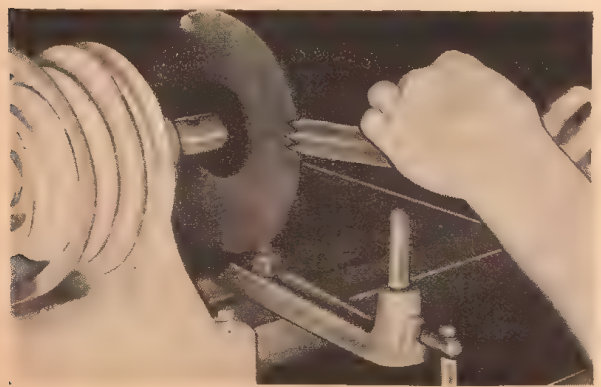
Below—With the V-block in an upright position, ends of round stock can be drilled.

A quarter inch cold chisel is the turning tool for brass used here.



Left—A disc of emery cloth glued on to a dowel stick gives metals, against which it is spun, a beautiful effect.

Those fancy finishes which one sees upon some metals are easily reproduced in the home workshop. One of the most popular effects is produced by tying a piece of emery cloth over the end of a wooden stick which is clamped in the chuck on the head stock of the lathe.



Metals can be cut very easily; the bakelite-carborundum metal cutting disc is used as you would an emery wheel.

When holding metals, such as sheet brass held up against the spinning emery, a circular spot is produced on the work. The work is then moved to make another spot which overlaps the first spot, and the process is repeated until the whole sheet is spotted in a haphazard overspotting manner. The effect is unique. One may glue a small disc of emery cloth on the end of a wooden dowel stick and chuck the stick up against the work. The work should be pushed against the spinning emery by resting it on a face plate fitted on the tail stock, and feeding the work up by the tail stock feed handle. To preserve this effect on brass, it should be lacquered afterward.

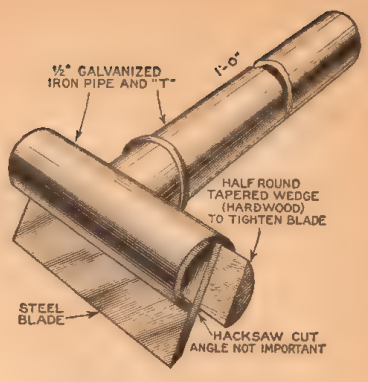
In drilling metals on the lathe one usually presents the metal to the spinning drill by feeding up the tail stock quill. In drilling holes in the walls of round stock such as pipe or round bars, a little wooden V block bolted to a face plate as shown in one of the accompanying photographs will be found to make the job easier.

Likewise in drilling the ends of round rods preparatory to tapping, the same V block will come in handy. It is placed on a tool rest support through the aid of a piece of stock acting as a pillar post. The correct height required to drill the exact center of the work is achieved by raising or lowering the pillar post by the set-clamp on the tool rest support.

Do not be limited by the suggestions which I have made. You will find that if you exercise ordinary care practice will enable you to work metals just as easily as wood on your wood lathe. Of course heavy work cannot be turned on a light machine, but you will surprise yourself by the excellence and finish of the work. You won't have to lay aside projects because you cannot fashion the materials involved. It is well worth your while to see for yourself what you can do along these lines. After a while you will be actually completing the jobs which you formerly could only want to do, and doing them well.

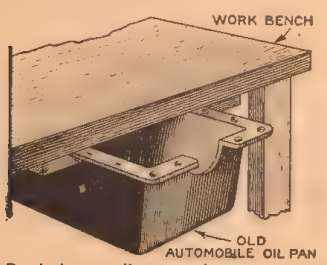
Try These in Your Own Workshop

The Home Workshop Can Be Compared to the Experimental Laboratory. Each Man Tests Those Ideas Which He Believes to Be Worth While. This Month We Present Six Which Have Been Found Practical


½" GALVANIZED IRON PIPE AND "T"
1'-0"
HALF ROUND TAPERED WEDGE (HARDWOOD) TO TIGHTEN BLADE
STEEL BLADE
HACKSAW CUT ANGLE NOT IMPORTANT

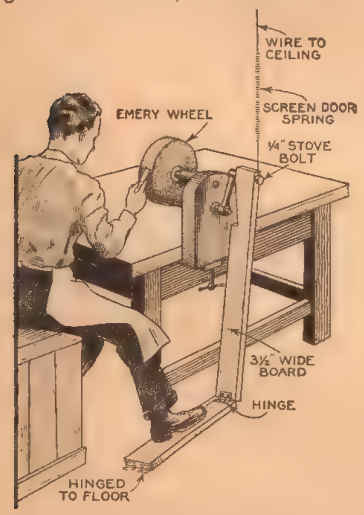
A real tool, and yet you can get the parts from a junk heap.

ONE of the first principles of workshop practice is that you must keep your bench tidy. Messy, disorderly, workrooms in which the tools and spare parts are scattered about haphazardly will never produce efficiently or well. Odds and ends can very conveniently be kept in a drawer beneath your work bench. The discarded oil pan of any automobile will serve admirably for this purpose. A successful way of mounting the pan is shown in our sketch.



Don't let small parts clutter up your work bench—provide a drawer like this.

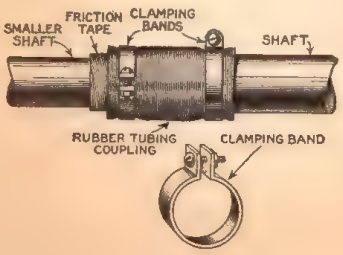
Many of us find it difficult to operate an emery wheel or grindstone with one hand and hold the work up against the wheel with the other. Too often in our efforts to keep the wheel turning we neglect the material, which we are fashioning. You can very simply adjust your hand wheel so that it can be operated by foot power, as illustrated. In this way, you will always have both hands free to guide the work. This is particularly advantageous when heavy or bulky objects must be ground. The added attention which you can give each piece of work will enable you to turn out a better finished article.



With both hands guiding the work, you can complete your grinding jobs more satisfactorily.

Apply an unusual finish to metal surfaces with steel wool.

Unusual and pleasing finishes can be obtained on articles built of brass, copper or aluminum sheet, by rubbing them with steel wool. The rough, whorl effect makes an attractive pattern. As the handling of a wad of this material is a rather tedious and uncomfortable operation, some sort of a grip or holder is very desirable. A good holder can be made from a child's hollow rubber ball. These are usually about two inches in diameter. The ball is cut as shown in the sketch. A little more than half of the ball is used. When stuffed with the steel wool it allows a firm grip.



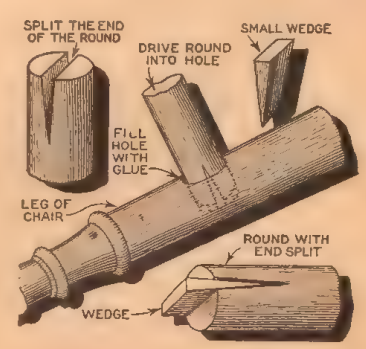
You would be surprised what an excellent universal joint can be made this way.

An extremely simple method for coupling two shafts together is shown in the accompanying illustration. The shafts are lined up and a piece of thick walled rubber hose of the correct inside diameter is slipped over the ends of the shafts. The hose should fit the shaft ends quite snugly. The ends of the shafts should not be more than a half inch apart; or the rubber tubing will permit too much of a twist when starting, which might break this coupling. A two-inch long coupling is about right; and hose with ⅛ inch thick walls is best because of its strength. If one shaft is slightly smaller than the other, it can be wrapped with friction tape until it is built up to the proper diameter.

The shape of the metal clamping bands, two of which are required for each coupling, is also shown in the illustration. Brass strips, ¼-inch wide and about 1/16-inch thick, are excellent to use for this purpose. The pieces are bent as shown and two holes are drilled for the tightening screws which can be round-head, 6-32 machine screws. After these bands are cut and bent, they are clamped around the rubber over the shafts.

The rubber hose can be easily replaced when it gets old and begins to crack. This type of coupling should not be employed if a very heavy load is carried by the shaft; as otherwise, it might be ripped, due to the inertia of the load when the shaft is started turning. For light loads, this is an excellent form of universal joint, and one that costs practically nothing to make. Another advantage is that this coupling will not transmit vibration.

Why not (*Continued on page* 1039)



Tighten up those creaky chairs.—Here's how.

New Tools You Can Easily Make

By Joseph Pignone

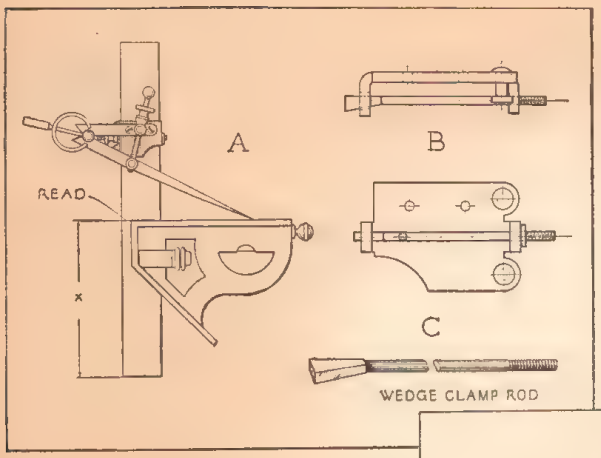


Fig. 1

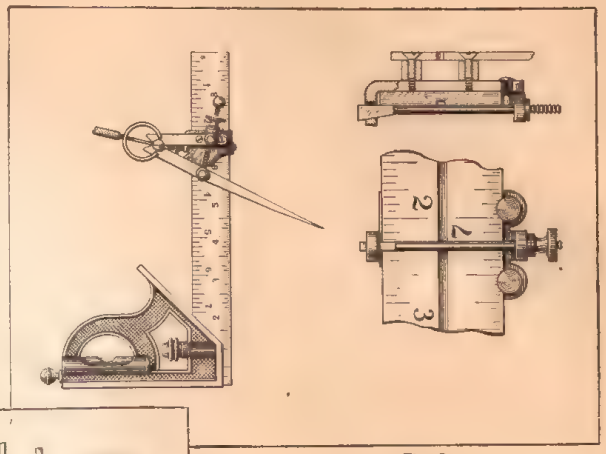


Fig. 2

A Combination Square Attachment

IN Figs. 1 and 2, the author has drawn one of the most useful and efficient tool attachments it has been his pleasure to design and construct. In unit with the ever popular combination square, a result is achieved which possesses inherent advantages over either of the tools it combines: the scope of the square is greatly widened, and as a surface or height gauge, measurements may be read directly from the tool itself with ease and precision. Lastly of course it is compact, simple and sturdy.

As illustrated in Fig. 2, a divider is properly altered to this purpose, although inside and outside calipers altered similarly might be better suited to some purposes. Then also, in combination with the center head of the square, a divider with its point bent laterally at ninety degrees might provide many additional valuable uses. Of course if two or more of the slide blocks as shown in B and C of Fig. 1 are constructed, all of the types may be made available. Although the attachment may be dimensioned for any square, the nine or twelve inch size is best suited because its head offers more contact area to a surface plate to assure of greater precision.

Little by way of detailed description is essential, as the idea is basically simple. However, it should be emphaticaly stressed that only the best and sturdiest divider or caliper ought to be utilized. Take it apart, and anneal the leg that the adjustment screw bears against. Then drill and cut it to mount on the slide head. Two collar standards must be inserted under this leg to maintain the adjustment nut clear of the ruler face.

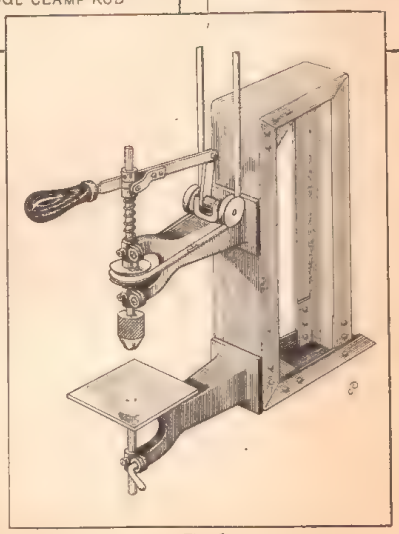


Fig. 3

The design and construction of the slide head proper is such that with little effort, accuracy is attained. No carefully planed or filed surfaces are called for, because the ruler bears against two sturdy bearing studs. They should be of ample diameter for strength and of brass to protect the ruler edge and graduations. The slide head body may be formed of one-eighth inch brass or steel properly cut and bent, while to make the wedge clamp rod as in B and C of Fig. 1, procure a short length of rectangular soft steel stock as wide as the maximum width of the wedge, and as thick. Center drill each end so that in turning the rod will appear as in B of Fig. 1. Then file the face of the wedge which bears against the ruler to a very slight taper, and the opposite outer face to a decided slant. When the ruler is inserted, the slightly tapered face must touch only the ruler and it must be at least a sixteenth of an inch from the rectangular hole face in the slide head.

The attachment is used efficiently with little effort and possible error. For surface scribing, clamp the head (as at A in Fig. 1) at a required dimension X from the bottom. Then slide the divider head down to approximately the required point and clamp the divider head screw. Now adjust the scriber point finely to the proper place by means of the divider adjustment nut. Unclamp the main head and invert and reclamp it to the proper position as in Fig. 2. Before reclamping however, wipe the base and ruler end and press both down on a plane surface.

A Practical Drill Press

AN easily constructed drill press is illustrated in Fig. 3, which, in reality may be made as accurately as the average small commercial press. A highly desirable feature is, that on this machine, the distance between the table center and the upright standard is far greater than on most small presses.

This drill press is built around two polishing heads of the better grade, which have split journal bearings. Preferably, they should be of half inch spindle size. As the various makes of polishing heads are of different size and form, no definite data is practical here, although a general description is needed.

Most important of course, is the form and construction of a suitable standard or upright on which the mechanism is mounted. Light channel iron is most easily procured and worked for this purpose. If facilities for bending this material to the bench drill form, as in

(*Continued on page* 1053)

Scientific Aids to Your Comfort

Equipment Featured in This Department Has Been Selected Because of Its Novelty, Extreme Practicability, and Reasonable Price

By Mary Jacobs

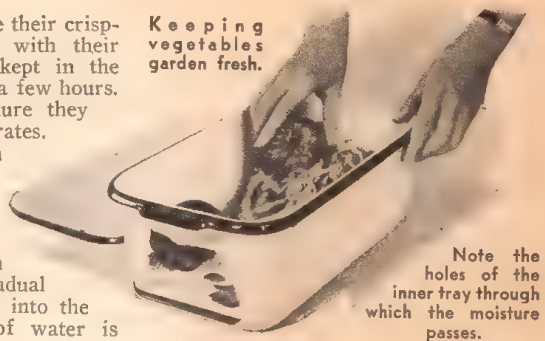
Cooking in Triplicate

HAVE you a space of about 8 × 8 inches available on your table? That's just what you will need for accommodating this compact electric table stove, of colorful enamel, nickel trim and aluminum equipment. You can prepare a breakfast of poached eggs, toasted English muffins, and broiled bacon at the same time; or if it's dinner you want, you can cream potatoes in the griddle, toast sandwiches in the rack, while steaks or chops broil in the deep pan. You will find a corrugated plate provided especially for broiling meats, along with its additional appliances, which include a griddle for baking and frying; four egg cups for steaming or poaching eggs, and a rack to hold them in position; and a toast drawer in which both sides of bread are browned simultaneously. Tested and approved in our laboratory.

Temperamentless Servant

IN these days of personal freedom and self-expression, it seems strange to talk of a model servant who is not afflicted with temper, an electrical servant who will do her best always, regardless of how you behave. . . . A truly portable washing machine! Now some statistics about this ideal helper: The initial cost is less than $40.00; operating charges are about one cent an hour; weight, 19 pounds. Based on the vacuum principle of operation, there are no moving parts to rip or tear your clothes. Can be used safely on silks, linens, woolens and cotton. Tested and approved in our laboratory.

LETTUCE and celery lose their crispness, and fruits part with their juiciness, when they are kept in the refrigerator for more than a few hours. This is because the moisture they contain gradually evaporates. So that they may retain their fresh flavor, and last for weeks without deterioration, there is an enamel container on the market which feeds them water to replace the gradual loss. It consists of a pan, into the bottom of which a cup of water is poured. An inner tray above it prevents food from getting wet, while the air is maintained at saturation point. A cover fits tightly over the container, so that other articles can be placed directly on top of it. It will also keep unwrapped sandwiches fresh. Tested and approved in our laboratory.



Keeping vegetables garden fresh.

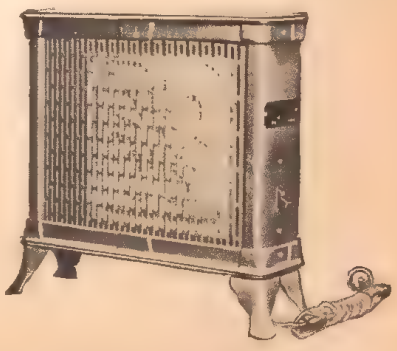
Note the holes of the inner tray through which the moisture passes.

When 2½ Makes 40

HERE'S the equivalent of 40 feet of clothesline within your arm's reach . . . eight 2½ foot double rods. This clothes rack, which comes in any colored enamel, can be fastened to a window or door casing, or on the back porch. A stand 54 inches high comes with it, should you want it to be supported from the floor. It can be swung out of the way when not in use, for the arms can be maintained in any position. Each arm is equipped with a rubber bumper to protect the enamel finish. Both rack and stand are collapsible, and can be folded away in the broom-closet. Satisfactory for indoor and outdoor drying. Tested and approved in our laboratory.

Annihilating Chilly Weather

IF you've ever got up early in the morning before the steam was up. . . If you've ever taken a bath in a drafty bathroom . . . if you've bathed baby in an improperly heated nursery, you will appreciate this portable electric heater. Its dimensions are 17×17×4¼ inches, and it operates from any outlet. It does not throw a beam of intense heat, but distributes it, partly through the interstices of the clover leaf design of the



metal grille, and partly through the top openings. Tested and approved in our laboratory.

Pop Goes the Corn!

OUT west, popped corn is an important breakfast food. In the east, this treat is reserved for picnics and circus visits, unless one is fortunate enough to own a corn popper. This aluminum electric corn popper can be used to prepare a breakfast food the children will like or for entertaining company at night. Its capacity is two quarts. The cover clamps on firmly so

(*Continued on page* 1032)

Names and addresses of manufacturers furnished upon request

Banishing Rust from Your Tools

Electroplating Is Considered a Task for the Expert Only; Yet the Amateur Can Prepare and Apply a Coating of Permanent, Non-Tarnishable Cadmium to Metal Surfaces

By L. Kay Wright

Member American Electrochemical Society

A tank of glazed clay, glass, or even wood, may be used as the plating vessel.

THE layman is concerned with rust itself and has no interest in the rather complicated chemical reaction which produces it. The general result of rust is weakening of the part or structure and it is obvious why aeronautical and marine fittings should be rustproofed.

Aeronautical structures are subjected to the cold found at high altitudes, and upon descending the chilled metal portions cause condensation of moisture—with consequent rusting, if not protected. Craft in operation at the seaboard, and lake regions in general, are subjected to continuous corrosive conditions, as spray is always to be looked for.

Where iron or steel abuts against aluminum or duraluminum it is usually insulated by a paper or fibre gasket, but vibration and alternate heating and cooling cause the absorption of moisture, and, of course, corrosion. The rustproofing method to be described will eliminate the electrolytic bugaboo, where steel and dural joints are made.

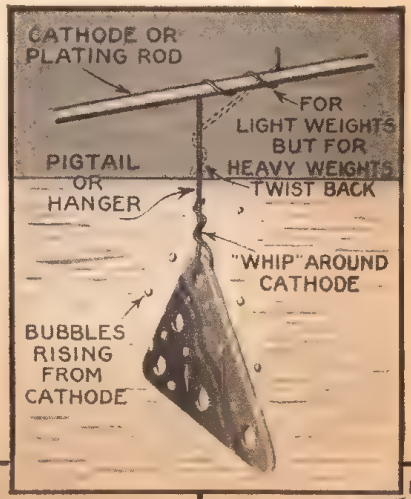
If small parts, such as small plane fittings, gusset plates, bolts and nuts, are to be plated, an ordinary radio or automobile storage battery of the six-volt type will suffice; but if large sections, such as sheets, long tubes, etc., are to be rustproofed, several cells will be required.

The drawing discloses two storage batteries connected in parallel. Any number of them may be hooked up, as per sketch. If desired, any other current source may be utilized. A direct current dynamo may be employed, provided a delivery of direct current at approximately six volts potential is obtained.

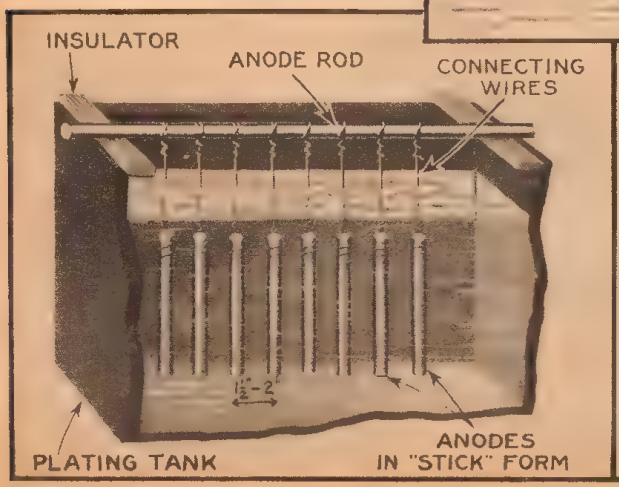
A tank of glazed clay, glass, porcelain, or even wood (if the latter, it should be paraffined) may be used as a plating vessel. The tank selected should be of ample size, as to length, breadth and depth, to accommodate whatever fittings are to be rustproofed.

Three brass rods or tubes, usually from ⅜" to ¾" in diameter, are laid across the top of the tank, resting on wooden insulator strips. Two of the rods, one on each side of the tank, act as anode supports, while the center rod (cathode) is used to support the articles to be plated.

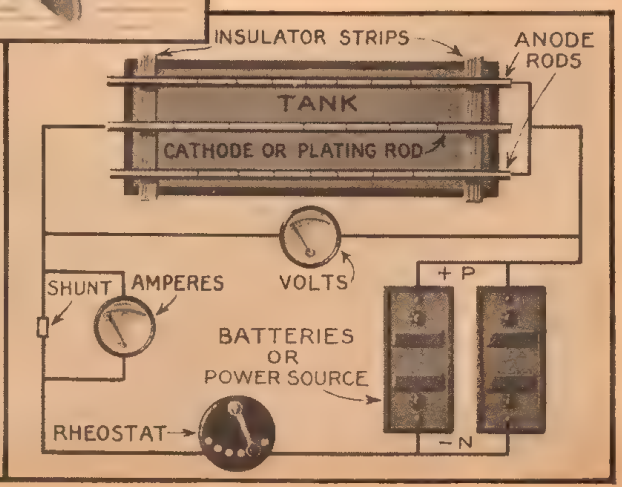
The anodes used are of pure cadmium, obtainable at any platers' supply house. For small work it is best to use the cadmium in "stick" form, which average from ⅜" to ½" in diameter and about one foot in length. Use soft, uncoated iron wire, of about No. 18 in size, to wrap around the ends of the sticks, and to (*Continued on page* 1047)


CATHODE OR PLATING ROD
FOR LIGHT WEIGHTS BUT FOR HEAVY WEIGHTS TWIST BACK
PIGTAIL OR HANGER
"WHIP" AROUND CATHODE
BUBBLES RISING FROM CATHODE

The object to be plated properly connected to the plating rod. Below—a typical arrangement of plating apparatus.



Pure cadmium bars are suspended by wires in the solution, 1½ to 2 inches apart. These form the anodes.



Prize Puzzles to Polish Your Wits

By Sam Loyd

THE Puzzle King presents the fifteenth of a series of problems, the solving of which will show if your mathematical ability is bolstered up by logical reasoning. Prize winners of the December puzzles and solutions will be found on page 1051.

A Puzzle in the Cloakroom

IN the early Nineties, there presided over the cloakroom of the old Astor House, at Vesey Street and Broadway, New York City, a young fellow who was the talk of the town on account of his uncanny ability to park his patrons' garments without the formality of issuing checks.

Despite numerous attempts to trip him up in the amazing performance, Tommy invariably handed out his hats, coats, canes and umbrellas to their rightful owners.

I always suspected that the boy employed some sort of ingenious system, but he insisted that he depended entirely upon his "camera eye" and supermemory, and we failed to discover any clue to the contrary.

Tommy was a good puzzle solver, and almost daily we exchanged riddles and other wit-sharpeners. On one occasion I had the satisfaction of "stumping" him with a puzzle posed on his own hatrack.

This particular rack, as shown in our sketch, consisted of 49 pegs in square formation. To make my proposition clear, I pegged nine hats and called Tommy's attention to the fact that I had formed three rows with four hats to the row. "Now hang up those other eleven hats," said I, "so as to have in your formation of twenty hats, the largest possible number of rows with four hats to the row." Of course, rows are to be counted obliquely as well as perpendicularly and horizontally—just so long as the four hats are in a perfectly straight line.

To show your answer, draw circles around the pegs where you elect to place the remaining eleven of the twenty hats, and at top of sheet set down your total number of 4-hat rows.

TWENTY-FIVE DOLLARS IN PRIZES

A FIRST PRIZE of $10 will be awarded to the person sending correct answers to the two puzzles accompanied by the best expressed analysis of the Real Estate Problem.

A SECOND PRIZE of $5 will be awarded for the next best analysis and correct answers to the two puzzles.

TEN PRIZES of $1 each will be awarded to the ten persons who send the next best analyses of the Real Estate Problem together with correct answers to the two puzzles.

Answers must be received not later than noon, March 16, addressed to "Puzzle Editor," SCIENCE AND INVENTION, 381 Fourth Avenue, New York City.

All contestants must abide by the decisions of Sam Loyd, who will examine all papers and award the prizes.

Papers of identical merit, tying for any one of the prizes, will each receive the full amount of the prize tied for.

Riches Come to Him Who Waits

A WISE old realtor, who had amassed a large fortune through the elementary system of buying tracts of land in the suburbs of growing towns and waiting for the rising tides of population to reach his holdings, decided to give a beneficent object lesson to his heirs

So he called a meeting of his sons and their wives and announced his intention of parcelling among them a nice piece of suburban land, stipulating in the presentation that their titles should remain undisturbed for a period of twenty years.

"Now, John," he said to the eldest son, "you may take as many acres as you can afford to carry, and your wife may take one-ninth of the remainder of the tract."

To the second son, he said: "Sam, you may take one acre more than John took, and to your good wife I will give one-ninth of what then remains."

In like manner he dealt with the next son, giving him one acre more than Sam took, and to his wife, one-ninth of the remainder.

Thus he continued with the younger sons and their wives until the entire tract was disposed of.

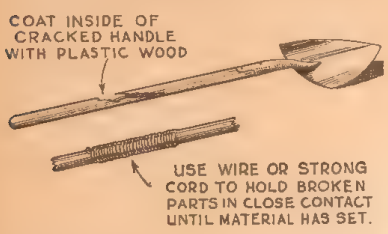
It then became apparent that the distribution had been most equitable, for each of the seven couples received a like number of acres.

If all of the land is eventually sold at the rate of one dollar per square foot, how much money will each of the seven families receive for its share of the estate?

Wrinkles and Recipes

For Broken Rakes and Hose

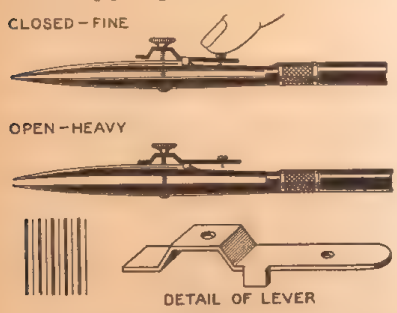
PLASTIC wood is very useful in repairing broken handles. Just give the inside a coating; have it wired or otherwise secured with strong cord so


COAT INSIDE OF CRACKED HANDLE WITH PLASTIC WOOD
USE WIRE OR STRONG CORD TO HOLD BROKEN PARTS IN CLOSE CONTACT UNTIL MATERIAL HAS SET.

that the wood makes close contact. Allow to dry and set as illustrated. After which sandpaper and finish with a coat of paint. This is an economical way of fixing broken implements.—*J. A. Westerberg.*

Drawing Pen Attachment

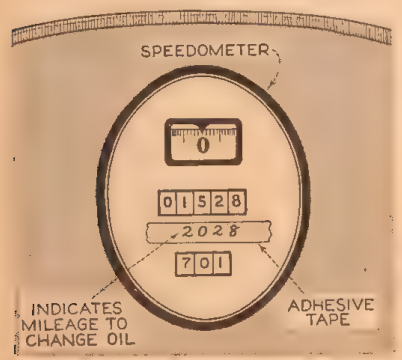
WHEN shading a drawing, fine and heavy lines are sometimes drawn. To simplify this task the device shown in the drawing was constructed. It is simply a piece of metal cut and



bent as shown. Pressing down on the strip closes the pen and makes a fine line; when released a heavy line is made. —*G. E. Taylor.*

For the Speedometer Indicator

TO remind the motorist when to oil and grease his car, a small piece of adhesive tape with the mileage written



in ink should be placed on the speedometer indicator on the dashboard. It should be renewed with each oiling and greasing.—*Jack Ridenour*

First Prize, $5.00

Prints From Photographer's Proofs

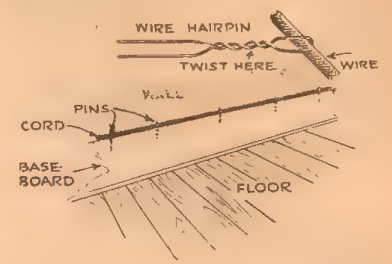
THOSE nice looking, quick fading, dark red colored proofs the photographer submits for approval to the person photographed can be copied. The prints will be permanent; but they will not be as clear and professional looking as the finished work of the photographer. They will be fuzzy, diffused; yet clear enough for a record or for tinting.

If a proof is to be copied, it must be done at once. The process is simple. Place the red colored proof face down on a piece of ordinary photographic printing paper, grade 2, semi-matte finish is splendid. If the proof is too large for the printing frame, use a heavy book for a base and cover with a piece of window glass to hold both papers flat. Due to the red color of the proof, about four minutes under a sixty-watt lamp will be required for the exposure. When this is developed, as an ordinary print would be, a negative print as on left will be obtained. Fix this print in hypo and dry thoroughly.

This paper negative is now used as if it were an ordinary film or plate, by placing it face down on a piece of printing paper and exposing this time about two minutes under a sixty-watt light. When the second piece of print paper is developed and fixed, the finished print will be permanent and in diffused tones of gray as shown on the right. When tinted and mounted in fancy folders these copied proofs make very artistic photographs.—*Ray J. Marran.*

Simple Lamp-Cord Holders

IT is often desirable to attach floor lamp cords, radio cords, and others to the baseboard or to a moulding. This is sometimes done with "horseshoe" nails or with insulated staples. An easy way to do it without marring the woodwork is by using ordinary wire hairpins or, better yet, the flat steel patented kind. With wire pins slip the cord into the pin, twist the ends of the pin a few turns, and insert them between the wall

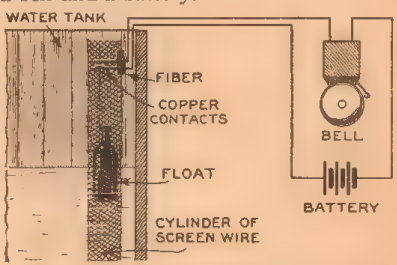


and the baseboard. The flat hairpins must have the flared ends clipped off first and need not be twisted. Either kind of pin will hold the wire snugly. —*Wayne Sprecher.*

$5.00 is paid each month for the best Wrinkle or Recipe accepted and published in these columns. All others used are paid for at regular rates. Address: Editor, Wrinkles and Recipes.

Telltale for Water Tanks

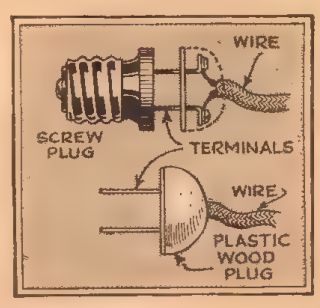
THE illustration shows a cheap and reliable telltale for water tanks. It consists of an ordinary quart bottle tightly corked, a cylinder of screen wire, a bell and a battery.



The bottle makes a good float and the screen wire cylinder keeps the bottle in proper place, so that when the water lifts the bottle it will bring the contacts together, close the circuit and ring the bell.—*R. C. Demary.*

Unbreakable Electric Light Plug

BY using plastic wood and a broken plug, an unbreakable one can be made. Insert the two prongs of the broken electric light plug into the screw plug. Connect two wires to the prongs or terminals as shown, place a cardboard



disc on the screw plug and proceed to mould plastic wood around into the shape of a plug. Leave for twenty-four hours before using.—*Gustave Brush, Jr.*

For the Home Machinist

By George A. Luers

Supervisor of Ordnance Design, Naval Gun Factory, Washington, D. C.

Do You Know How to Drill Large Holes on a light Press, Bolt Adjacent Parts, Countersink Boltheads, Drill Deep Holes, and Turn Eccentric Pieces?

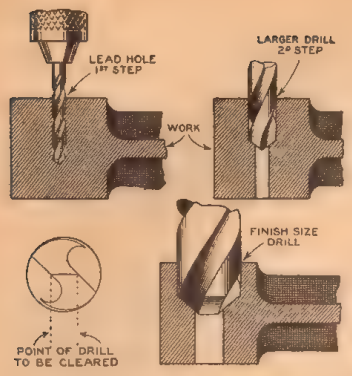


Fig. 1—How to drill large holes efficiently in successive stages, on a light press.

DRILLING of a large hole such as the bearing in a bracket, indicated by Fig. 1, is a job that occurs daily. Usually the hole is drilled at one operation using one tool in a heavy drill press. If done on a light drill press in successive steps, using drills of different sizes, the work will not be likely to strain the press and the position of the drilled hole can be held more readily.

Start with a small drill, and carry it through the casting. Follow with an intermediate size, which will feed readily by reason of the clearance provided by the first hole. The finishing drill is then used and the pressure required to feed the tool is reduced to about one half. In each instance the drill employed is of a diameter sufficient to clear the lineal point of the drill to be used in the next operation.

Bolts fastening work are of three general types, the cap screw, hexagonal head bolt and countersunk bolt. The recesses to accommodate these in the work are machined in the drill press, using tools illustrated by Fig. 2.

The counterbore for seating a cap screw is made with a pilot of the size of the body or shaft of the screw or bolt. The spot facing, for a hexagonal head bolt, is made also with a counterbore, having a diameter larger than the widest part of the bolt head.

The countersunk bolt recess is cut with a tool having correspondingly shaped cutting edges. This tool also is provided with a pilot end to center the cutters. The tools are sometimes made by grinding down short broken drills to provide the pilot ends and in other instances cold rolled steel or drill rod is used and a double end cutting blade is inserted in a slot through the bar. A third method is to make the cutter of one bar and drill the end out for the insertion of the pilot. The pilot can then be changed to meet the needs of various jobs.

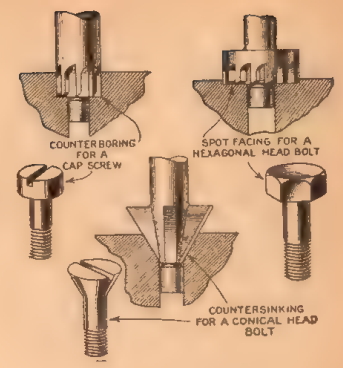


Fig. 2—Some of the tools used in sinking bolt heads flush with the surface of the work.

The adjacent part to be assembled on a job, such as a cap, cover or bracket, should have bolt holes spaced properly to insure a snug fit of bolts. On individual jobs, jigs are not practical because of the cost. Under these conditions it is desirable to locate holes from the bracket or cover. To do this, the part is temporarily clamped in place, a drill is selected the exact size of the bolt hole. With this, each place for bolting is spotted lightly. This is followed by drilling with the tap size drill as shown by Fig. 3. The hole can then be tapped, using the bracket as a guide for the tap. This method insures reasonably accurate fit of bolts.

In cases where through bolts are to be used, the parts should be clamped together and the drill run through both pieces at the same drilling.

When drilling holes of considerable depth, the majority of times the drill emerges at the far side of the work off center. When necessary to drill straight true holes, central with respect to the work, the method shown in the lower view of Fig. 4 has been found to give the best results.

A job frequently encountered in the shop is that of the turning and boring of eccentric parts.

It is advisable to omit the drilling operations until the work is turned. Two examples are shown in Fig. 5, in which the stock is laid off to establish the offset. The points of offset are then drilled for lathe centers. By means of these the work can be swung in the lathe, using either a dog or the face plate chuck. The center points allow for turning, without need for special offset arbors as would be required if the work was first bored out. Upon completion of all the external turning work, the boring or drilling can then be completed using either the lathe or drill press.

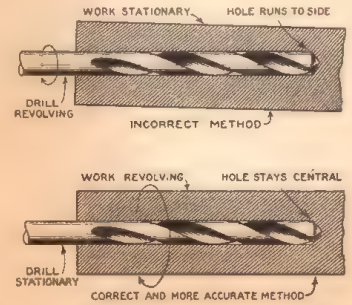


Fig. 4—Let the work revolve instead of the drill and deep drill holes will not run off center.

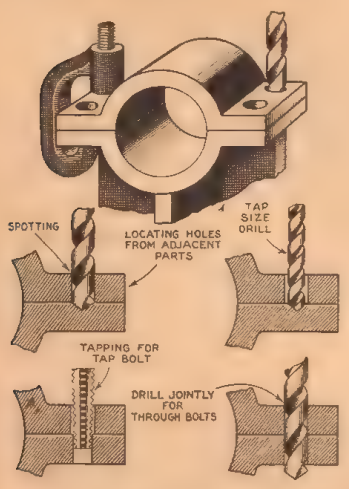


Fig. 3—Eliminate guesswork in fastening adjacent parts and obtain cleaner and more accurate, finished work.

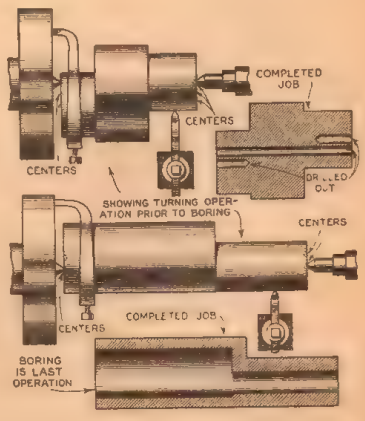


Fig. 5—Eccentric parts should be turned first and drilled and bored afterwards. Try it and see the difference.

Conducted by
Seymour A. Davidson

The Disappearing Costume

(2381) Mr. Randolph E. Ryerson of Auburn, Mass., writes:

Question 1. Some years ago in a musical comedy the following effect was produced. The company was apparently dancing in a ballroom. Without any cessation of action, the scene was transformed to that of a garden, even the appearance of the actress' clothing changed. How was this done?

Answer 1. The costumes were made of celophane. Let us suppose red celophane was used. Stage scenery likewise had a covering of celophane. Beneath the celophane the actors wore another costume and beneath the celophane, covering each stage setting, was a second scenic display.

If a red light is thrown on red celophane costumes they become transparent and whatever is worn beneath will show up. When a blue light is used the red celophane appears black. The red costume shows up in its natural color under a white light.

Use Your Old Electric Light Bulbs

(2382) Robert Trelaine, Chicago, Ill., writes:

Question 1. I have a number of blown out, large, electric light bulbs. Will you please tell me what use I can make of them? Also explain the easiest way of cutting this kind of glass.

Answer 1. The bulbs will serve several purposes. You may use them as fire extinguishers. The screw bases are cut off and the necks fitted with corks. The bulbs are filled with carbon tetrachloride. Several of these containers can be held in wire racks which are quite similar to the ordinary ring stands found in any chemist's equipment. In use the bulbs are flung into the flames where they break and spread their smothering contents.

You will be surprised by the handy flasks you can make. In addition to the changes already described, the rounded, globe-like portion, of each bulb is flattened, so that the flasks will maintain an upright position, full or empty.

By breaking off the tip—in the modern lamp the tip is concealed by the screw base—and filling the bulb with water an excellent sprinkler is obtained. The trouble incident to many uses to which discarded lamps appear to be applicable is due to the thin glass. There is little strength to it and if the end of a large bulb is cut off you will make it a weak vessel.

For use in experiments with alternating and high potentials the old evacuated lamps must be used. It's hardly necessary to mention that lamps of this kind do very well as electrodes, when performing experiments with high frequency currents.

Now you want to know how to cut the glass. Try this. Tie an oil soaked string around the bulb at the point at which you wish to cut it. Light the string. Then plunge the bulb into cold water. A nice, clean, even, break will result.

One more method. Make a nick in the glass with a triangular file. Heat a glass rod, a clay pipe stem, or a heavy wire. When it becomes red hot touch it to the nick and push slightly in the direction in which you wish to cut. The glass will crack immediately under and in front of the rod. Heat the rod again. Reapply it to the glass. Keep this up and you'll be able to cut the most interesting and intricate designs.

Storage Battery Plate Hardeners and Binders

(2383) Mr. R. P. Robidoux, Robstown, Texas, writes:

Question 1. Please advise what binding and hardening media are added to the oxides used for both the positive and negative storage battery plates. What is the average length of time required for the drying of the plates?

A. 1. Hardeners and binders are occasionally added in the preparation of the paste which is applied to storage battery plates to increase the coherence and the hardness of the plate. A great variety of substances have been used for this purpose. Glycerin and litharge are probably the best known of these materials for making hard plates, but the present practice is to control the plates' hardness by selecting the proper combinations of oxides and solutions rather than to resort to the use of hardeners. The drying operation is seldom completed in less than a day and may require several days, according to the material used.

Sun's Rays Color Glass

(2384) Mr. Stanley Bowden, Whitewater, Calif., writes:

Question 1. We have noticed a strange thing on the California desert. All glass that has been exposed to the sun for any length of time turns to a beautiful shade of violet. The longer the glass is exposed the deeper and richer the color becomes. Is it true that this change is caused by the glass absorbing the ultra violet rays from the sun? Would this changing of color be confined to any locality?

Answer 1. What actually happens to glass, exposed to the sun for a great length of time, is not definitely understood. It is quite possible that the actinic rays of the sun produce this change. They assumed to effect a molecular rearrangement which is easily hastened by X-rays. Some glasses turn purple and others green after they have been exposed to powerful X-rays for as short a time as 10 minutes. This technique has been employed practically in coloring eyeglasses.

This strange reaction has been noticed in many localities. It is not peculiar to any one clime or altitude, but can be observed wherever the air is clear enough to allow the more active sun's rays to penetrate.

The Most Powerful Electro-Magnet

(2385) Mr. William D. Edds, Battle Mountain, Nevada, writes:

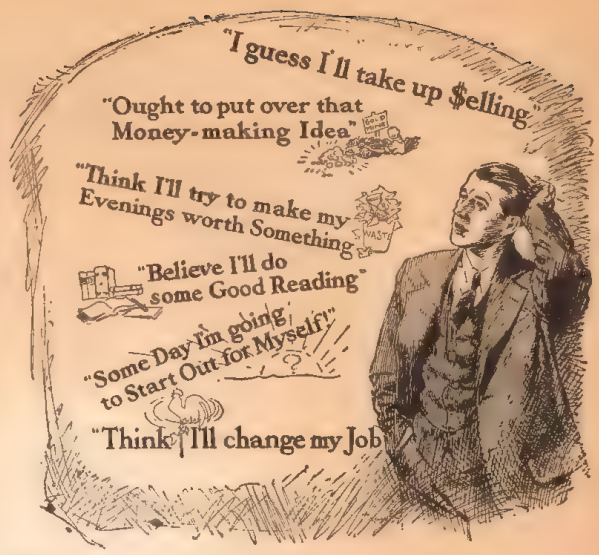
Question 1. I would like to know how the strongest electro-magnet can be made.

Answer 1. There is no limit to the strength of a magnet which can be produced electrically. The power of the magnetic lines of force depends entirely upon the kind of metal used as a magnet core, the number of turns of wire comprising the magnet coil, and the current employed. An increase in the amount of metal in the core, a greater weight of metal in the coil, and a larger current strength give a corresponding increase in the attractive and repulsive effect which the magnet will produce. Soft iron for the core and double cotton covered copper wire for the coil are the materials generally used.

Retention of the magnetism may be reduced by building the core of thin iron plates dipped in shellac.

The Oracle is devoted to questions of general interest to our readers. Direct mail answers will be given at the rate of fifty cents per question.

The Man with the "Grasshopper Mind"


"I guess I'll take up $elling"
"Ought to put over that Money-making Idea"
"Think I'll try to make my Evenings worth Something"
"Believe I'll do some Good Reading"
"Some Day I'm going to Start Out for Myself"
"Think I'll change my Job"

YOU know this man as well as you know **YOURSELF**. His mind nibbles at **EVERYTHING** and masters **NOTHING**.

At home in the evening he tunes in the radio—gets tired of it—then glances through a **MAGAZINE**—can't get interested. Finally, unable to **CONCENTRATE** on anything, he either goes to the **MOVIES** or **FALLS ASLEEP** in his chair.

At the **OFFICE** he always takes up the **EASIEST** thing first, puts it down when it gets **HARD**, and starts something else. **JUMPS** from **ONE THING TO ANOTHER** all the time!

There are thousands of these **PEOPLE WITH GRASSHOPPER MINDS** in the world. In fact they are the very people who do the world's **MOST TIRESOME TASKS**—and get but a **PITTANCE** for their work.

They do the world's **CLERICAL WORK**, and routine drudgery. Day after day, week after week, month after month, year after year—**ENDLESSLY**—they **HANG ON** to the jobs that are smallest-salaried, longest-houred, least interesting, and poorest-futured!

If **YOU** have a "grasshopper mind" you know that this is **TRUE**. And you know **WHY** it is true. Even the **BLAZING SUN** can't burn a hole in a little piece of **TISSUE PAPER** unless its rays are focussed and concentrated **ON ONE SPOT**!

A BRAIN THAT BALKS at sticking to **ONE THING FOR MORE THAN A FEW MINUTES** surely cannot be depended upon to get you anywhere in your **YEARS** of life!

The **TRAGEDY** of it all is this: you know that **RIGHT NOW** you are merely jumping **HERE AND THERE**. Yet you also know that you have **WITHIN YOU** the intelligence, the earnestness, and the ability that can take you right to the high place you want to reach in life!

What is **WRONG**? **WHAT'S** holding you back?

Just one fact—one **SCIENTIFIC** fact. That is all. And when you know what it **IS**, then you can easily learn how to apply it; make it carry you **STEADILY, POSITIVELY, AND DIRECTLY** to prosperity and independence.

That fact is one which has been **PROVEN** and stated by the world's foremost scientists and psychologists. You are only **ONE-TENTH** as successful as you **COULD** be! Why? **BECAUSE**, as Science says, you are using only **ONE-TENTH** of your real **BRAIN-POWER**!

TEN per cent of his brain is all the **AVERAGE** person uses. He is paid for **ONE-TENTH** of what he really possesses because that is all he actually **USES**. The remainder lies dormant. The longer it is unused, the harder it becomes to use it. For the mind is like a muscle. It grows in power through exercise and use. It weakens and deteriorates with idleness.

What can you **DO** about it? That is the question you are asking yourself. Here is a suggestion.

Spend 2c for a postage stamp. Send in the coupon below for a copy of "Scientific Mind Training." There is no further obligation whatever. You need not spend another penny.

This little book will tell you the secret of self-confidence, of a strong will, of a powerful memory, of unflagging concentration. It tells you how to acquire directive powers, how to train your imagination (the greatest force in the world), how to make quick, accurate decisions, how to reason logically—in short, how to make your brain an instrument of all-around **POWER**. It tells you how to banish the negative qualities like forgetfulness, brain fag, inertia, indecision, self-consciousness, lack of ideas, mind wandering, lack of system, procrastination, timidity.

Men like Judge Ben B. Lindsey, Sir Harry Lauder, Prince Charles of Sweden, Jerome K. Jerome, the famous novelist; Frank P. Walsh, Chairman of the National War Labor Board, and hundreds of others equally famous, praise the simple method of increasing brain power and thought power described in this free book. **OVER 700,000 OTHERS PRAISE IT.**

You have only **TWO CENTS** to lose by writing for your copy. You may **GAIN** thousands of dollars, peace of mind, happiness, independence!

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NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

Perpetual Motion

(1249) Charles F. Finger, Los Angeles, Calif., presents a diagram of a device which he claims is the nearest thing to perpetual motion. He claims that a patent on this has been filed by *The Buoy Motor Company.* The device consists essentially of an oval shaped tube fitted with valves in the left leg to hold back a quantity of water also in this leg. Balls are so arranged in this system that they are supposed to pass down in the right leg and ascend through the column of water.

A. The idea itself is merely a variation of an item that appeared back as far as 1825. It is entirely inoperative for the simple reason that the downward pressure upon the valves is sufficiently great to prevent the ball in tending to rise from lifting the valves. Ultimately, the water comes to the same level in either leg and then the system is even more incapable of operation if such a thing is possible.

Transmitting Electric Power

(1250) Andrew Perry, New Bedford, Mass., submits an idea for transmitting electricity through the air which involves plates of glass or mica bent to the form of a horseshoe or half-circle, with a high tension plate in the middle and with outside brass plates. He asks about the market possibility.

A. We can conceive of no reason why your apparatus should work. We do not know of any fundamental law of electricity which would allow for the operation you hope for. We would suggest that you outline the reasons for its assumed operation and what you would intend to accomplish with such a system should it only transmit a very limited amount of power.

Summer and Winter Bed

(1251) Mr. Lucien Biernat, Chicopee, Mass., submits an idea for a bed which will be warm in the winter time and cool in the summer time. This change is effected by means of refrigeration or heat, passing through steel tubes in the mattress.

A. We are extremely doubtful that a suggestion of this nature would in any way be practical. Maintaining a mattress considerably cooler than the body is bound to lower vitality to such an extent that colds can be easily contracted. Heating the body is also not a very good idea. It is extremely doubtful that any manufacturer would undertake the construction of a device similar to that which you describe. It is simple enough that if a room is kept warm the bed will also be warm. Why go to the trouble of merely heating the mattress?

There are electric blankets on the market today that will supply the necessary heat and these by conduction will also heat the mattress enough to make it decidedly comfortable. They possess the advantage of having thermostatic controls, and can be cut off by their switch.

Seat Indicator

(1252) Thaddeus Stefanowksi, Hollywood, Calif., submits a suggestion for an empty seat indicator for theatres which will indicate in the lobby which seats are empty. He requests our opinion.

A. The idea is not new. If you will have a patent search made, you will find that a great many different types of empty seat indicators have been protected. We do not know of any theatre in which any of these devices has been installed and we cannot comment upon the practicability.

We are inclined to believe that due to the constantly shifting patronage in the motion picture theatres, such seat indicators would be of little value. By the time a person in the lobby locates the theatre seat, some other patron would have moved down to occupy it. The ushers with their lights would have to show the people down the aisle because their eyes have not yet become accustomed to the darkness.

Water as Fuel for Gas Engines

(1253) H. F. Harn, Toledo, Ohio, requests some information about the possibility of using water as a fuel for gasoline engines. Exactly how the water is to be used is not made clear in the description.

A. The idea of employing water as fuel in engines is not at all new. Water has been decomposed electrically and the oxygen and hydrogen have been combined in the cylinders of a motor and exploded to produce power. Unfortunately, a greater amount of energy in the form of electrical current is needed to dissassociate the water than the motor will possibly produce in the form of mechanical energy. If you have discovered a new system for utilizing water, which tests prove to be highly efficient, it certainly would be advisable to proceed with a patent application on the method outlined. But try it out first.

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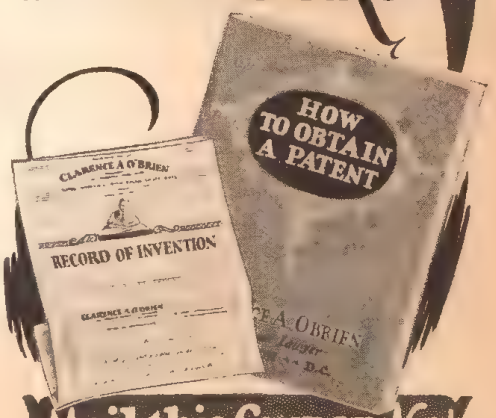

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Among the Inventors

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Plane-Refueling in the Air Made Simple

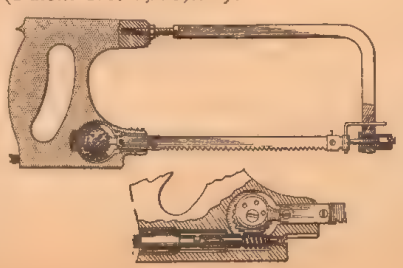
THE gay Lothario of today, has deserted the road to ride the skies with a fair miss as his companion. Were he to announce that the fuel tank was

practically dry when no landing field was available—it would be just too bad. Mr. Haverhill is well aware of the possibility of a situation such as this occurring. According to letters patent number 1,746,966, there is a preventive. All that is necessary is to dot the landscape with his emergency refueling stations which include a tower, storage tank, pump and hose. These will enable an aviator to obtain gasoline without coming down to earth.

An airplane would circle the tower and let down a grappling iron. The hook is to engage the hose. As the plane makes contact with the pipe an operator causes the upper portion of the tower to revolve so that it keeps pace with the airplane which is circling it. Simultaneously the pumps are started and the plane's tanks can be filled in a few minutes.

Motor-Driven Hacksaw

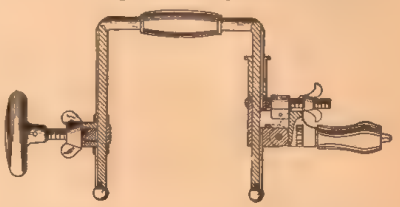
ALL of our butchers know how to wield their knives. But when it comes to bone cutting—well, that's another story. For the average butcher it's just another one of those disagreeable jobs that has to be done day in and day out. However, it is intended that his labors should be considerably lightened by the use of a hack saw with a motor—reciprocated blade which has recently been patented by Mark A. Plut (Patent No. 1,775,692).



According to the inventor the oscillating movement of the motor-driven blade is actuated by practically all the power needed for cutting the bone—the operator merely guides his tool.

The Bit Brace That Gets Into Corners

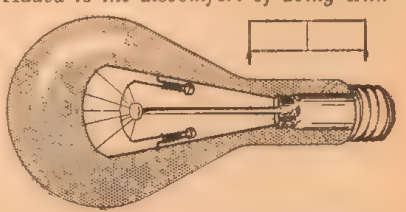
THE bit brace is one of the hardest working tools in any workshop. Be it metal or wood that is being worked, there are very few jobs that can be finished without the use of this handy implement. But there's a rub. It's hard to use in corners even if it is a ratchet type and getting into tight places presents usual difficulties. Samuel Harris through patent No. 1,771,958 has done away with most of this inconvenience. He has designed an adjustable bit brace



which can be fastened in several different positions so that various leverages may be obtained. The chuck of this brace is mounted on a swivel joint so that boring can be done at any angle.

Multifilament Lamp

A SUDDEN surge of current in the line, an accidental tap, the rumbling vibration of a passing truck—any of these may prove to be too great a strain for the white-hot filament of the electric lamp which burns so brightly. Added to the discomfort of doing with-



out light until another bulb is procured is the expense entailed in replacing a lamp which might have been expected to give many more hours of service. Charles Sproesser and Ernst Anton Lederer have endeavored to eliminate these inconveniences by providing a lamp which is the subject of patent No. 1,760,667, with several filaments.

The filament circuits within the bulb are so arranged that when one burns out another is shunted into service.

Why Electric Clocks Keep Time

(*Continued from page* 980)

chronous and induction motors depend upon fairly pure wave form for dependable operation, especially the synchronous motors, whose speed is a direct function of frequency. If the frequency varies, the speed varies in direct proportion. And, as we have said, our clocks are still another reason.

During a recent visit to the largest electric power plant in the world, the Hell Gate Station of the United Electric Company in New York City, Mr. H. Y. Hall showed us just how they manage to maintain such narrow limits of frequency variation. We were surprised at the ingenuity and simplicity of the system. At a master control station, a very accurate clock is used. This is not an electric clock, but one with a very high grade and expensive weight-driven movement. Twice daily, this clock is checked by radio, the time signals of the Navy Radio Station, NAA, in Arlington, Va., being accepted as standard. Each of the power stations of the company has a duplicate of this clock, with a special dial. Each sub-station clock is checked thrice daily with the master control clock, at 9:30 A.M., 1:30 P.M., and at 5 P.M. Thus all of the clocks are kept exactly alike.

Two Seconds Tolerance

As we have mentioned, the sub-station clocks are identical with the master clock, except the dials. On the sub-station clocks, a small dial gives the time in the conventional manner, and a larger dial is so arranged that the hand makes one complete revolution in five minutes. This hand is of natural brass color. In front of this hand is another hand which is driven by an electric movement operated from the lighting lines. This hand is black, so that it stands out in bold relief from the brass hand behind it. An operator, constantly on watch, controls the speed of the generators so that the two hands are exactly coincidental with each other at all times. The maximum allowable variation is two seconds in either direction, and if even this small variation occurs, it is immediately offset by an equal variation in the opposite direction, so that the average is exactly 60 cycles at all times.

Mr. Hall also explained that manual operation of the speed on the generators was far more accurate than any form of automatic control yet invented. This is true because a governor on the generator would not take effect until an actual change of speed had occurred, and then it would only tend to bring the speed back to normal, without the correction factor that is made possible with manual control. This "hunt" of a governor permits of variations in speed which are too wide to give sufficiently accurate control. A glance at Fig. 1 will show how close the control actually is.

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More Sound Lumber from Packing Cases

By Roy F. Chander

A Little Care Plus Ingenuity Enables You to Turn Cast-Off Boxes Into Valuable Lumber

You do not need a saw and you do not need a block of wood. Just place your hammer as closely as possible to the nails. Press and the job is done.

Be careful that the saw does not engage any nails.

Knock the pieces out with a block of wood. Above, using the saw to cut a box apart.

THERE is a lot of really good lumber going to waste in this country day after day. Wood suitable for constructional purposes is being used to heat homes and start the fire in the morning. Next time you come into possession of a discarded crate, box, or case examine it a bit more closely before relegating it to the woodpile.

Make sure that you do not burn lumber from which you can make that extra shelf, needed so badly in the kitchen, or that little smoking stand you intend to build some day—when you get a chance. Perhaps you yourself have often felt that a good deal of the wood that eventually is stacked up near the furnace could serve a better purpose if you only knew how to take crates apart without splitting the sides. Careful salvaging of wooden cases yields a surprisingly large amount of workable, sound, lumber which you will be able to turn to good account in your home workshop. Try the suggestions which are included in this article. The extra time spent and the slight expenses incurred will be amply repaid.

In reclaiming and salvaging such material, you can very well use a nail puller. This handy tool sells for less than a dollar and a half. With it, you can remove nails from boxes and crates after which the structure falls to pieces.

One may saw the side boards away from the ends with a hand saw, to secure the longest of the stock. It is no job at all to hold a wooden box up against the revolving blade of a motor shop circular saw in this operation. Gauge the box along the path that the blade is to travel for nails, however, otherwise you will ruin your saw.

Side and bottom boards can be knocked off by hammer blows applied to the end of a short length of a two by four held against them. This will prevent their splitting as is often the case when the boards are themselves struck directly with the hammer head.

Large crates and heavy packing cases are sometimes made of poplar which mars so easily because of its softness that the best salvaging method is by the use of an automobile jack and several wooden blocks of different sizes. This method results without exception

A nail puller makes your salvage work much easier and much more profitable. Below, automobile jacks have been used for all sorts of purposes. Try this the next time you break up a box.

in almost a 100 per cent salvage, for it will remove large boards without marring or splitting them.

The ends of boxes and cases are usually made of dressed stock about 7/8" thick. As the sides, top, and bottoms are nailed to this, it will be encircled with nail holes after the surrounding wood is removed. These holes are effectively plugged by hammering into them matches of the "strike anywhere" variety.

Magic

(*Continued from page* 1009)

discover any difference in its thickness, after the mysterious message has been produced.

The Ice Miracle

A METAL box with a hinged lid about eighteen inches long and fourteen inches wide and of the same height is placed upon a small skeleton-frame metal table. The box is tipped forward and its lid is opened, permitting the audience to clearly see that there is nothing concealed within the box. The lid is closed and the box replaced in its original position. A bucket, containing water, is now emptied into the box. A small lighted oil lamp rests upon a shelf beneath the table, directly below the box. After the lamp has burned for a time, the lid of the box is opened, and instead of the water steaming, as would be commonly expected, the performer reaches into the box and brings forth a large cake of ice.

The box has a false back and bottom secured at right angles to each other working upon a shaft, as illustrated. Therefore, the ice, which was originally concealed inside the box, rests upon the shelf in back of the box, after it has been tipped over, and the lid opened. As the lid is closed, and the box placed in its original position, the ice re-enters through the opening in the back. The water from the pail which is actually emptied into the box escapes through the four hollow legs of the skeleton table.

Novel Coin Vanish

MAGICIANS have long wanted a coin-vanish glass of water combination. To satisfy this demand an effect ingeniously simple may be secured by the use of a stemmed tumbler with a flat base, instead of an ordinary goblet. A genuine coin is used.

The coin is placed beneath a handkerchief, held over the goblet, and is distinctly heard to drop, but immediately upon removing the handkerchief, the coin has mysteriously vanished.

As illustrated, one will note that the coin, hidden by the handkerchief as it falls, secretly strikes the base of the tumbler, thereby creating the necessary clink. The coin is then palmed in the hand holding the goblet.

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Short Waves Menace Battleships

(*Continued from page 977*)

considerable magnitude are induced in conductors in the vicinity of an energized antenna whenever their electrical length is such as to approach resonance with the antenna, and that potentials are induced in large metallic bodies, insulated from the ground, when in a strong field under an antenna. An example of the first kind is the current induced in standing rigging not broken up by insulators; an example of the second, is the spark which can be drawn from an automobile parked under a large energized antenna."

In other words, if a conductor or any part of a conductor like a gun happened to have resonance qualities which practically made it a receiving antenna for the shortwave being transmitted from the ship's short wave radio antenna, there is a decided danger that the gun, if loaded, might be fired prematurely. Remember that practically all gunfire on Uncle Sam's fighting craft is now controlled by electrical wiring, an electric spark touching off the firing charge.

There are also three chief dangers from what is called the "chance resonance condition" between the transmitted frequency and the length of the conductor attached or in close proximity to explosives and inflammables:

1. Resonance between the transmitter and the firing leads of exposed broadside or anti-aircraft guns which might cause premature firing (but not before the breech, and hence the firing circuit, is closed up to the firing lock).

2. Resonance between the transmitter and a gasoline filling hose, which might result in a spark setting off the explosive vapor mixture present during filling operations.

3. Resonance between the transmitter and the wiring to wing-tip flares on aircraft in the vicinity, which might ignite the flares while the planes are on deck or on the ground, causing serious fires.

Real hazards, these, and the Navy research men aren't through studying them yet. However, to guard against the hazard of a chance resonance between the transmitted frequency and a conductor attached to or near explosives and inflammables, the experts found that a small filter system could be devised for firing circuits and all exposed mounts. Nevertheless, orders were to *shut down short wave transmission* while *exposed* guns are firing.

As for fuel filling hoses it was strictly ordered that they be grounded, the connection being made direct from the hose nozzle to the filling aperture before the filling cap is removed and that it shall be broken only after the cap is closed. Planes, too, were required to be grounded to the metal of the ship.

In the old days, the use of the so-called intermediate waves, those between the high and low frequencies, meant that any potentials developing in isolated metallic objects in the field of the transmitting antennas could be eliminated by the mere expedient of grounding the object. The muzzle of a gun produced no potential of easily detectable proportions.

Then came the higher frequencies and grounding was not very effective. On turret No. 3 of the U. S. S. Texas, for example, it was found that the muzzles of guns became quite hot when a nearby antenna was excited at 16,000 kilocycles (18 meters) at only 1-kilowatt output. The muzzles were approximately three-fourths of a wave-length from the trunnions, which would effectively have grounded them at any of the intermediate or lower frequencies.

The guns of turret No. 3, in fact, are a full wave-length long for certain frequencies, the trunnions being approximately one-quarter of a wave-length from the breech and three-quarters of a wave-length from the muzzle ends. With the muzzle end of the gun exposed to a high frequency field it is possible to set the whole gun into oscillation electrically with the result that low, through readily measurable voltages, can be detected on the gun at the breech even though this end is quite well shielded from the electric field of the antenna by the turret, a bulletin of the Navy Bureau of Engineering reported.

At this same turret it was found that the radio energy under certain conditions made it possible to light an 18 to 24 volt lamp by connecting it between the breech of a turret gun and the turret; explode a primer in the breech of the turret gun by using the energy fed into the turret by a special tuned circuit arrangement; light airplane running lights when the aircraft is exposed to the field of the antenna, and set off the primers on airplane wing-tip flares.

The U. S. Aircraft Carrier Langley and the battleship Texas leading the fleet during the training manoeuvres.

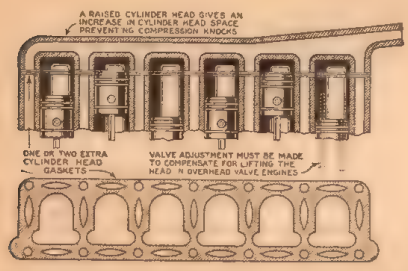
What to Look for in a Used Car

(*Continued from page* 1008)

cast iron pistons, .002 of an inch for aluminum alloy pistons. This is measured by means of a thickness gauge, inserted between the piston and cylinder.

Where the piston fits too tightly, it is necessary to lap or grind it in position in the cylinder, using fine emery and oil or valve grinding compound, working over the full length of the cylinder. Since the head of the piston becomes hotter than any other part, it requires slightly more clearance than the skirt, as shown in the attached illustration. When the car is first driven with new pistons, it is advisable to have a quart of oil in the gasoline, the same holds true when breaking in a new motor.

The high compression engine will knock when run on plain gasoline, with the slightest accumulation of carbon. Ethyl fuels prevent knocks, but add to the expense of operation. To prevent the slight pounding in the engine it is necessary to frequently clean out the carbon. Another method, shown in the illustration, is available to the car


A RAISED CYLINDER HEAD GIVES AN INCREASE IN CYLINDER HEAD SPACE PREVENTING COMPRESSION KNOCKS
ONE OR TWO EXTRA CYLINDER HEAD GASKETS
VALVE ADJUSTMENT MUST BE MADE TO COMPENSATE FOR LIFTING THE HEAD IN OVERHEAD VALVE ENGINES

One or two gaskets inserted between the cylinder block and the head will silence knocks.

owner. It is to reduce the compression by raising the engine head. This is done by adding one or two gaskets in the joint between the head and the cylinder block. The usual copper-faced gaskets are placed one above the other, being shellacked together and bolted down solidly under the cylinder head. It is necessary to compensate for this on overhead valve engines by adjustment at the valve stems.

Some clutches slip, some grab and others spin. Most times the fault is due to carelessness and neglect on the part of the owner. Observe the rules and clutch troubles will not occur.

Don't use the clutch pedal as a foot rest. Don't use oil on a dry clutch. It is permissible to flush with gasoline if the clutch gets oily or greasy. Never glaze the discs by slipping the clutch where a lower gear should be used. Install floor boards carefully so that the clutch pedal is not being pushed forward. Don't over-lubricate the clutch thrust ring to the extent of getting grease on the discs; nor let the clutch in while the engine is racing or the discs will ultimately be damaged. For oiling, a wet type of clutch, use only the specified grade and quantity as recommended by the manufacturer.

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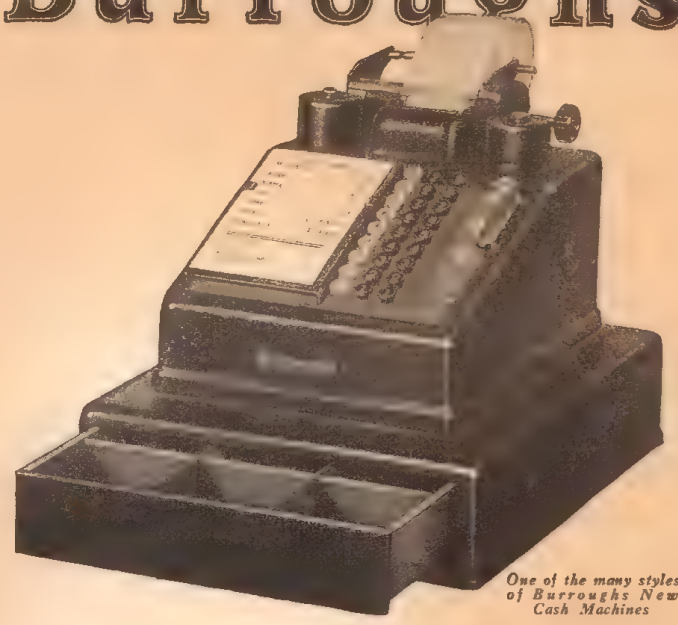

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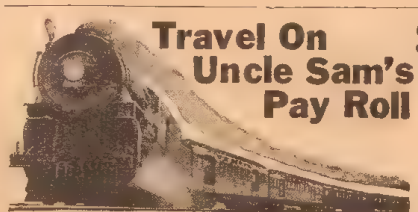

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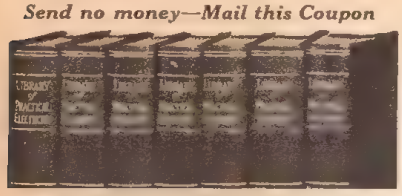

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It Is Safer to Kiss a Dog

(*Continued from page 979*)

Unless it is certain that the dog was not mad, the doctor will give the Pasteur prophylactic treatment, which consists of a series of harmless injections. This treatment will prevent rabies. If it is omitted when one has been bitten by a rabid dog, death will almost surely result.

If every dog were muzzled for a period of two years, there would be no more rabies. The disease is kept alive by allowing rabid dogs to bite others. If this were prevented, all rabid animals would soon die off.

Even a healthy dog may frighten your child badly enough to do harm, without actually biting. I know of a family with small children who were so afraid of the neighbor's police dog, which was let loose without muzzle or leash, that they did not dare to leave their own front porch. On several occasions, when the dog jumped upon the children and knocked them down, their nerves were so upset that they could hardly eat for several days afterward and had to stay home from school.

Frights such as this, even in the absence of physical injury, are harmful. They tend to make the child timid or moody in after years.

Under all ordinary circumstances, however, man's friend, the dog, is a safe member of the household — far safer, indeed, than your neighbor's child who comes in to play with your children before she has fully recovered from the measles or whooping-cough.

What has been said with regard to dogs applies also, to a large extent, to cats. But pussy is generally cleaner and more fastidious than her canine rival, if not so good natured. True, she may scratch little Anna when she attempts to dress her in dolly's clothing, or even pounce upon Tommie when he ties a tin can to her tail. But children soon learn to respect feline dignity after kitty has given them tit for tat several times.

Are Cats Carriers?

It used to be thought that cats could carry the contagious diseases of children. One of the bitterest experiences of my childhood was the loss of a pet Maltese cat which was taken away from me when I was convalescing from scarlet fever. Nowadays, it is realized that human beings carry the contagion. The most serious affliction I ever saw carried by a cat was ringworm. It came to my attention through the gift an acquaintance of mine gave to his lady friend. He presented her with a handsome Angora, which she fondled day and night, until a patch of ringworm developed on her forearm and she discovered the cat had the "mange."

Cats are the ministers of sanitation, too, because of their enmity to rats and other rodents. It is safe to say that if Europe had been overrun with cats instead of rats during the Medieval Ages, many millions of lives would have been saved. The "Black Death," spread to mankind by rats and rat fleas, destroyed one-fourth of the population of Europe during the fourteenth century. In 1664-65, it carried off 70,000 of the population of London, which then numbered half a million. The toll was so terrible that the bodies were carried away in common carts, and every morning the streets of London echoed with the familiar cry, "Throw out your dead."

Her evident faith in cats is well founded. They can be safely fondled.

And so let us wish kitty nine long lives and a robust appetite at the expense of our deadliest foe, the rat.

Another popular children's pet is the rabbit. Bunny was once a favorite in the nursery. And he had a good record, too. Nobody ever suspected that he would be guilty of carrying disease to mankind.

But Science is inexorable. A new disease, affecting rabbits and carried by wood ticks or blood-sucking flies from rabbit to man, was discovered. Huntsmen and people who were accustomed to handling rabbits called it "rabbit fever." Doctors called it *tularemia*.

The public became panic-stricken. Bunny was ostracized from the household, and hasenpfeffer was banished from the diet of many who had hitherto considered it most delectable. Not altogether without reason, too; for seventeen human cases of tularemia were traced to rabbits sold in a single market in Washington, D.C., while nine other rabbits offered for sale here were found to be diseased.

But not all rabbits are carriers of tularemia. Certainly the bunnies sold in pet shops or raised in rabbitries are safe and free from the disease. There is no reason why they should not still be kept as pets.

The wild jack rabbits, and also the snowshoes and cottontails, particularly in the western part of the United States, are the principal animals affected. In California and Utah, also, a large num-

ber of ground squirrels have the disease and can give it to huntsmen or others who come near or handle them.

Tularemia is spread from rabbit to rabbit largely through the agency of the wood tick, a spider-like creature that infests its fur. It may be carried to man either by this tick or by the bite of a blood-sucking fly, the deer-fly, which is commonly found on horses during the early summer months in Utah and the vicinity. Also, if the housewife dresses an infected rabbit for dinner, she may become infected through a scratch on her finger. But neither is in danger of tularemia from eating the hasenpfeffer because cooking destroys the microbes.

If we remember that only the wild jack rabbits, cottontails and snowshoes are likely to be infected with tularemia, while the domestic rabbits raised in the rabbitry are practically always free from the disease, there is no reason why we should not allow the children to keep tame bunnies as pets.

Wild rabbits may spread disease, but domestic rabbits are safe.

One of the most alarming diseases transmitted by pets, and one that has caused much public concern, is the illness carried by sick parrots, *psittacosis* (pronounced sit'a-ko'sis).

A most instructive experience with regard to this disease was recently reported to the Albany County Medical Society by three doctors connected with the Albany Medical College (Drs. L. W. Gorham, F. G. Calder and J. D. Vedder).

Last Christmas day, Mrs. A. S., a woman of 34, received a present of a South American parrot, which had been purchased from a dealer in Schenectady. On the following day, the bird seemed ill. It drooped in its cage and its feathers ruffled out listlessly. The cage was badly soiled and the parrot evidently had diarrhea. No longer was Polly destined to shock or amuse company with her flippant speech.

Mrs. S. nursed the parrot and cleaned her cage frequently. In this duty she was helped by her mother-in-law, her husband, and her two daughters, aged 5 and 10. But the bird grew worse.

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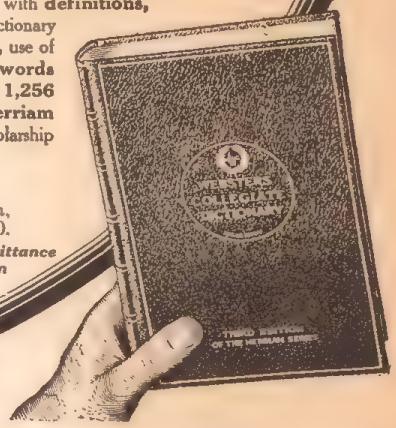

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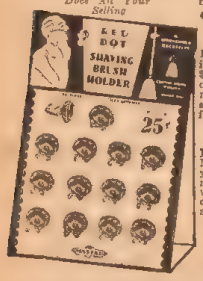

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all the world like influenza with pneumonia. In spite of conscientious treatment, she became weaker day by day and passed away on her twelfth day of her illness.

In the meantime, her husband, accidentally reading a newspaper account of psittacosis four days after his wife became ill, suspected the parrot and killed it, burning the bird together with its cage.

However, it was too late to prevent infection, because all the members of the household had been in contact with the parrot.

On the Wednesday following the Thursday on which Mrs. S. became ill, her mother-in-law was afflicted with the same symptoms. On the following Wednesday, both children were sick, and on Friday the husband came down. Fortunately, these four members of the household recovered.

When the history of the parrot in this case was studied, it was found to be one of a shipment of three hundred which had arrived in this country from Colombia.

So many cases of psittacosis have recently been traced to sick parrots that the Government passed an embargo upon their importation. The gay plumaged birds are still forbidden entry into the United States, unless they have been under observation for two weeks. And with good reason, when we consider that in the epidemic of psittacosis last Christmas time 169 persons caught the disease from parrots, of whom thirty-three died. It seems that the most dangerous type is the Amazon species, which is largely shipped to Hamburg, Germany, and distributed from there around the world.

Last year there was a tremendous epidemic of psittacosis among parrots in South America. A large percentage of them died. Other parrots, apparently in good health when they left port, became ill on the high seas and many of them died before reaching their destination.

The microbe responsible for psittacosis has not yet been found. It is probably too tiny to be seen under the microscope. But there is ample reason to believe that it is abundantly present in the discharges from the sick parrots, and that human beings who handle the birds or their cages are likely to become infected. And it is a serious disease, too, since approximately one-third of the cases prove fatal.

If you have recently acquired a parrot, observe the bird carefully. Be on your guard if it sits huddled up with its eyes closed or its feathers ruffled out, or if its head is turned on its shoulder. Watch out if it avoids the perch, refuses to eat, shivers, or passes frothy greenish droppings. These are common symptoms of the disease in parrots, fraught with danger to the person who tends the cage.

By all means, avoid contaminating your fingers by the soiled cage and be sure to wash your hands most thoroughly afterward.

Some parrots with psittacosis do not appear ill, yet they can carry the disease. Also, it is important to beware of the bite or peck of the bird. Some of the serious human cases have started in this way.

Whatever your pet, be it dog, cat, rabbit or bird, be sure that it is in good health before allowing your children to play with it. If the animal appears sick, if you have any doubt at all, safety demands that you take it to a veterinarian for an examination.

This will not only protect yourself and family but also, in many cases, save the life of your pet.

Building Modernistic Whatnots

(*Continued from page* 1002)

the level of the surface, or even above it, where it can be sanded when dry.

As to other imperfections, occurring in the growth of the tree, loose knots should be removed, tight knots should be brushed over with a couple of coats of shellac to act as a filler, and cracks should be filled before painting operations are begun.

For the filling of cracks, knot holes and other open imperfections, there is nothing that will equal the crack fillers that are prepared for use by the addition of water, forming a paste that fills, dries hard in a few hours, can be nailed into and chiseled or sawed like wood. In other words, it becomes part of the piece itself. As an aid to anyone making nice furniture from poor wood, it occupies first place.

The painting of the piece will follow the usual prescribed method — primer or undercoats, carefully rubbed with fine sandpaper, followed by the final enamel coats. Quick drying paints will expedite matters and give better results because they will be more likely to dry free of dust.

The shelves illustrated were all finished in the same manner, ivory enamel with the edges trimmed in black. If modernistic designs or patterns are desired, the sides can be painted in these.

Placed beside an easy chair, one of these modernistic whatnots becomes a useful as well as decorative article of furniture. It provides a convenient place for a box of candy or for the smoker's cigarettes and ash tray, as well as a place for the favorite books that he may wish to read while he smokes.

Modernistic furniture is becoming very popular. We have only to visit the movies or look in the show windows to realize this. I am wondering if our readers would like some more articles on modernistic furniture, a great deal of which can be made up out of otherwise waste materials? We would be glad to have you express your wishes with regard to articles of this type or any other that may interest you.

Ants Fight Like Humans

(*Continued from page* 983)

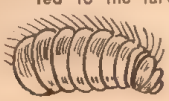
the night a caged wildcat! I have known them to kill pigs in their sties, by crawling into their brains through the snout. It has happened that babies, who had been left for a short time on the ground by their mothers, have become their victims.

"The little brother of a servant of mine in the Tahita mountains of British East Africa, was killed in this way.

"The rapidity with which Siafu spread over the body of animate things, whether man or beast, is amazing. Old residents in Zanzibar will remember the sensation that was created when the wife of a foreign consul, walking with her husband on the *Muari minoja*—the fashionable road of African Ceylon—having inadvertently stepped into a procession of warrior ants, was so rapidly infested by the enemy that, wild with pain and disgust, she tore off her clothes and stood naked.

"A friend of mine, who lived near Lake Victoria, once told me how a guest of his, who was sleeping in the same room, near the window, was attacked by Siafu in the middle of the night, and was already covered with them when he awoke. He jumped out of bed, tore off his pyjamas, and started dancing about, yelling for his boys to come and pick off the insects. But when they arrived running, he, instead of standing still, began boxing their ears because they did not do it fast enough, whereupon they, believing that their master had gone mad, ran out of the house again, terrorized, leaving him to shift for himself."

Three stages in the life of every ant. The kind of food fed to the larvae determines the type of insect which will result.

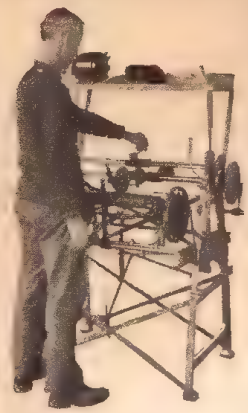


Above—Ant eggs. Next—Larva. Right—Newborn insect.

If these vicious ants get into the roof of a house it is almost impossible to combat them or get rid of them. This is all the more difficult because most of the roofs are thatched.

"I remember one occasion," the naturalist said, "when this happened to me. I had a cat, with three kittens, living on the roof, to reach which she had to climb a tree and then jump across. She carried her children down when the invaders appeared, one after the other and saved them all; but I had to pick out Siafu afterward from the skins of the lot, including the brave mother."

It is perhaps as well, say the scientists, that such fighters are unable to effect treaties of peace among themselves for if they did, they might organize against animal life, and even against humans, and such a war would be terrible to contemplate in many respects more so than the great battles of history.



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Cooking a Banquet

(*Continued from page* 984)

know all that his waiters and cooks know, and have a pretty accurate knowledge of the appetites of his passengers. He must also have an understanding of the little fourteen-foot box that embraces every corner and every bit of the space. The alley is lined with racks filled with aluminum, perfectly polished. The ranges, the ovens, are black. But everything is spotless.

The aluminum space given to the pantry has a sink and tiny work table. It is just wide enough for the pantryman to work with his hands without turning about very much. All about are convenient places to put salads and ingenious dishes.

In the dish-washing space there is a sink with two tables, and above it there are ten slots, each sized for some particular dish or place, into which the plates go from the top. Then there is the ice box and the range and the warming cabinet and the broiling oven. The fire—and it's a hot one—is made from charkets, which cost sixty dollars a ton, but which generate just the right amount of intense heat.

Also included are the coffee tanks; and everywhere racks where various utensils are placed. Handy to every part of the tiny compartment is the refuse removal system, where it can be opened quickly for dropping in the unwanted food. There is no waste motion anywhere; no going from table to stove, to cupboard, to garbage can, to flour bin, to stove. It just can't be done. Everybody wants to eat and there isn't time—and there isn't room.

Col. G. H. Emerson, of the B. and O. R. R., inspects the air-cooling device.

In the tiny kitchen there is always food enough for all who want something to eat. The stewards pride themselves on this. First, by using that well-known law of averages, they can tell very closely just how many passengers will be with them on any particular day of the week and on any particular run. And according to the type of passengers they estimate the food required. But there is always something in reserve for the unexpected.

"A man tried to catch me," said one of the stewards after showing the wonders of his fourteen-foot box. "He asked for a caviar sandwich, and didn't expect to get it. But I had it for him.

"One day, on one of my runs, a whole parcel of college boys got on unexpectedly and wanted a banquet! Well, I had no advance notice, but, believe me, we gave 'em their banquet from soup to nuts! As a consequence the crew and I didn't have much to eat that night, and there wasn't any surplus to report the next day."

Acrobatic Waiters Who Can Juggle!

Of course the railroads have stores along their lines. But the fast trains between New York and Chicago and Boston, and Washington and Baltimore have to count accurately on their short runs. Transcontinental trains have compartments below the floor to carry extra food. Then they may wire ahead for additional supplies.

But, with all this, the steward must depend upon the well-known law of averages to do the trick. This law is the surest thing there is, and helps to make his reputation, if he abides by it.

For example, the steward knows that out of every hundred persons, eighty-five will wish coffee and fifteen will order tea. Thirty-five will want roast beef. After roast beef, chicken comes next in favor, then fish, chops and steaks. For dessert most travellers order fruits, fresh or canned. Puddings come next, then apple pie. Ice cream, of course (of which nearly a million quarts are served annually) comes fourth on the list of favorites for dessert.

And don't forget the waiters. They have had a course of rigid training before being put on trains. Carrying a big tray of slippery dishes while the train is making sixty miles an hour or lurching around a double curve is an art.

Scientific Aids to Your Comfort

(*Continued from page* 1013)

that it can be tipped upside down, when all unpopped kernels will drop out. The stand prevents its ruining the table; the long handle remains cool even when the bowl gets hot. Tested and approved in our laboratory.

The Pygmy Planets

(*Continued from page* 985)

asteroid was named Ceres.

The next year Olbers, while searching for Ceres, found a second minor planet which, by rare chance, happened to be near Ceres at the time. A third was found by Harding in 1804 and a fourth, again by Olbers, in 1807. These four asteroids (which have diameters as follows: Ceres, 480 miles; Pallas, 304 miles; Juno, 120 miles; and Vesta, 240 miles) are by far the brightest, and after the discovery of Vesta, no other members of the group were found for 38 years, because astronomers did not search for sufficiently faint objects. (See Fig. 1.) Quite a number were added during the years succeeding 1845, but it was not until 1891, when Max Wolf introduced photographic methods, that their number began to multiply enormously. No longer was it necessary to measure and painstakingly remeasure every star in the field of the telescope. A photograph of several hours' duration recorded the positions not only of the stars and asteroids but enabled the astronomer immediately to distinguish the two by the motion of the latter during the exposure. (See Fig. 2.) As many as 100 asteroids have been discovered in a single year by this method until now well over 1500 objects have been located and there are, doubtless, many more still waiting to be discovered.

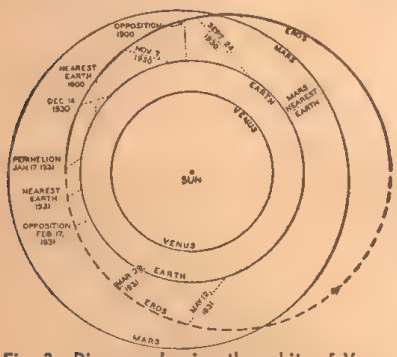

Fig. 3—Diagram showing the orbits of Venus, Earth, Eros and Mars. The ends of the short dotted lines joining the paths of Eros and the Earth mark the positions of these planets on the dates given near each line.

The orbits of the minor planets lie between the orbits of Mars and Jupiter. Their periods of revolution about the sun range from one year and nine months to almost fourteen years. There are probably a dozen asteroids, other than the original four, that have diameters between 150 and 100 miles. Possibly one hundred and fifty more have diameters exceeding 50 miles, but the great majority are still smaller, down to 15 miles, 10 miles, or even less in diameter. Most of these sizes are estimates based on the observed brightness of the planetoid and an assumption about the ability of its surface to reflect sunlight, but they are probably correct as regards order of magnitude. Swarming as the heavens are with asteroids, only one, Vesta, ever attains naked-eye brilliance. Eros, at closest approach, fails of this objective by some two or three times. The majority of asteroids are, however, much fainter. Vesta's brilliance, despite its diameter, (it being the smallest of the original four) must be attributed to a white surface of relatively high reflecting power.

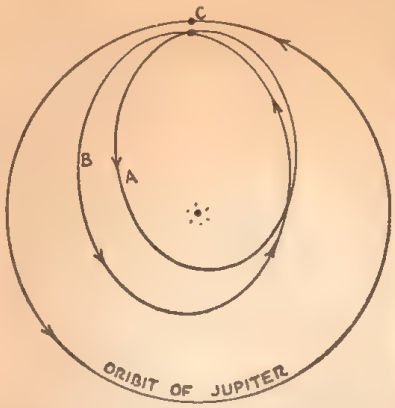

Fig. 6—A, original orbit of the asteroid. The close approach of the asteroid to Jupiter, at C, causes a change of orbit to B, owing to the attraction of Jupiter.

In order to escape from the earth, a projectile would have to be shot away with an initial speed of about seven miles a second. From the moon the velocity of escape is about 8000 feet a second. From Ceres, the largest asteroid, any object, for example a rifle bullet, projected with a speed of 1700 feet or more a second would never fall back to the surface, while from little Eros, which is only fifteen miles in diameter, an ordinary base-ball thrown with an initial speed of 55 feet per second would leave the planet never to return. On Eros it would be a simple matter for a man to "play catch" with himself, by throwing the ball entirely around the planet and catching it on its return. No matter how he threw the ball it would always return to the starting point provided only that the original speed was greater than 40 feet per second and less than 55 feet per second. Of course he would have to take the precaution of always throwing the ball *parallel* to the planet's surface. Such a game of catch might, however, be a trifle monotonous. After tossing the ball far into the east, a man would have to wait more than an hour and a half until the ball would come flying back to him from the west. If he decided to take a nap in the interim and happened to oversleep, the damage would not be serious. He could catch the ball on its second or any subsequent round for, if left to itself, the ball would continue to circle the planet like a tiny satellite.

On Eros, the small gravitational attraction would be notable in other ways. Walking would be rendered rather difficult. The accustomed force that raises the body's center of gravity but an inch or two from the ground on our planet, would send a man flying a hundred feet or so into space. With as little effort as a terrestrial runner takes an ordi-

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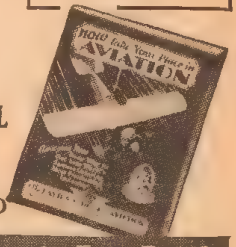

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nary hurdle, the same runner on Eros could leap as high as the Empire State Building, the tallest structure on the earth. (See Fig. 5.) Nor would he be in any particular danger for he would float down far more gently than a parachute-jumper, and strike the ground with a force no greater than that of the terrestrial hurdler. It would require no tremendous strength to lift a freight car, weighing 30 to 40 tons, high over one's head. (See Fig. 4.) These asteroids, of course, are airless, like the moon, for their gravitational forces would be unable to hold the swift moving molecules of gas that form an atmosphere.

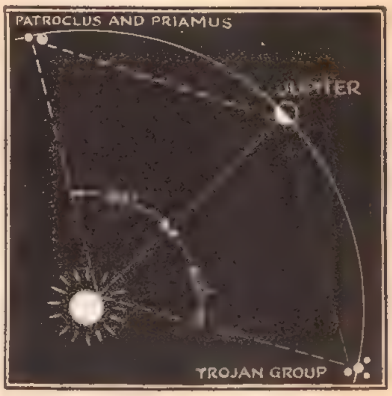


Fig. 7—The Trojan group of asteroids which share the orbit of the planet Jupiter.

We know that Eros, and many other asteroids as well, are rotating on their axes. The evidence of this is a regular recurring variation in brightness, as if one side of the planet were darker and thus reflected less light than the other. The length of the day for these minor planets ranges from about 3 hours on Eunomia to almost 9 hours on Tercidina. Eros turns in 5 hours and 16 minutes, a period that still holds, as observations obtained during the past few months indicate. In the case of Eunomia we have unmistakable evidence that the direction of rotation is the same as that of the earth, from west to east.

What are these asteroids? Are they pieces of a much larger body that burst into fragments long ago? Or are they débris that, for some unaccountable reason, failed to collect into a single planet when the solar system was formed? The first hypothesis, that they originated by disruption of but one body, is quite untenable. K. Hirayama, however, has found several groups of asteroids whose present orbits are such as to suggest that a break-up of a larger body might possibly have been responsible for each of the respective groups. For the present, the origin of the asteroids must remain a subject for speculation.

The old woman who lived in a shoe had an easy life compared to that of astronomers. To keep track of 1500 or more children is a task that most of us would shun. Not the least of the difficulties is the fact that the asteroids refuse to continue in the same orbit year after year. A large part of their waywardness must be attributed to the action of Jupiter, whose gravitational force is quite sufficient to warp the orbit out of shape. (See Fig. 6.) It is not surprising that some asteroids occasionally get lost. Aethra was lost immediately after its discovery in 1873 and, in spite of frequent search, was not found again until 1922.

We should not fail to note one particularly interesting set of asteroids, known as the Trojan group, owing to their having been named after heroes of the Trojan war. These planets have yielded completely to the insistence of Jupiter's pull and share the orbit of the giant master, though situated 60 degrees away, so that the sun, Jupiter, and asteroids stand at the vertices of an equilateral triangle. (See Fig. 7.) Four of the Trojans, Achilles, Hector, Nestor, and Agamemnon precede Jupiter, while the remaining two, Patroclus and Priamus, are sixty degrees behind. It seems rather singular that the bosom friends, Achilles and Patroclus, should thus be separated for all time by 120 degrees.

But why the recent interest in Eros, as indicated by the opening paragraph? The orbit of the planetoid with respect to those of the earth and Mars is shown in Fig. 3. Owing to the peculiar shape and size of the orbit, a very close approach of Eros can occur but once or twice a century. One occurred in 1894, four years before the planet's discovery. In 1901 it came within 30,000,000 miles of the earth. The nearest Eros can ever come to the earth is 13,840,000 miles and the January 30, 1931 apparition was within 2,500,000 miles of this minimum.

Why Eros Interests Astronomers

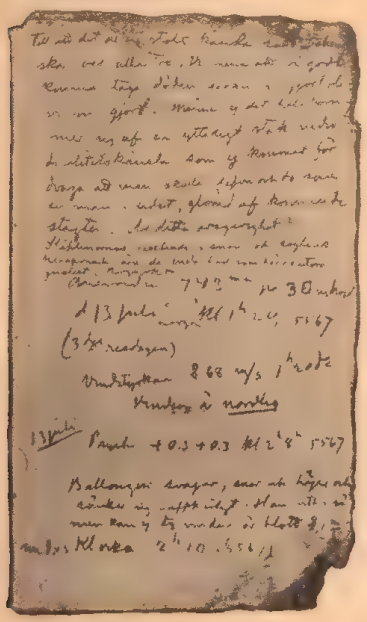
As in 1901, astronomers took advantage of the close approach to determine with extreme care the exact distance of Eros from the Earth. It is fairly easy to draw a diagram similar to that of Figure 3, showing the Sun and planetary orbits on a very accurate relative scale. It is much more difficult to determine the precise value of that scale. If, however, we are able to measure with precision a single distance represented on the chart, e.g., the space between the earth and Eros, all other distances become known. The actual distance to Eros is, for astronomers, merely a stepping stone to a more accurate determination of the size of the solar system. The distance of the sun, according to the mean of the best older determinations, is about 92,870,000 miles with an uncertainty of 10,000 miles or so. The purpose of the 1930 and 1931 Eros observations was merely to decrease the already small margin of uncertainty. The method of observation requires little explanation. Eros is so near the earth that its apparent position among the stars depends appreciably upon the observatory's location upon the earth. Simple surveying methods are employed. By comparing observations made at different observatories, the astronomers can calculate the distance by triangulation.

Andree's Photos Reveal His Fate

(*Continued from page 989*)

ended the lives of three very gallant gentlemen.

The films taken by Andrée and his companions were developed by Professor J. Herzberg, of the Photographic Laboratory of the Royal Technical University, Stockholm, whose story of his feat is as follows.



A facsimile of page 11 of Andrée's diary, containing the latter part of the entry he made on July 12, 1897, when the balloon was motionless over the ice.

It was with very small hope of being able to develop the Andrée pictures, or even obtain any traces of pictures, that I received the rolls of films handed to me for examination and treatment. A latent photographic picture grows fainter in time and even disappears, especially if the time of exposure has been short—a factor which, in the present instance, had to be considered.

We also knew that the celluloid of the film sometimes acts on the emulsion coating, producing in the course of time an ever-increasing, veiling-effect. This leads the manufacturer always to fix a period within which the film must be developed if the picture is to be a clear one.

Regarding the films which the Andrée Expedition took, this period ended in February, 1898. On the other hand, there are films which have been properly exposed and which, between exposure and development, have been preserved in a cool and dry place, or not subjected to great variations of temperature, which have given serviceable, even though greatly veiled, negatives after ten, even twenty years.

On examining the contents of the copper cylinders containing the Andrée films, it was found by the way in which they were rolled that, of the seven rolls, four had been exposed.

All the lengths of film down to the spool were wet, some of them to such an extent that the layer of emulsion came off from the underlying celluloid if merely touched by the finger.

My first step, after numbering and weighing the cylinders, was to unroll the films from the spools and to dry them. This had to be done with greatest possible caution because of the decomposed condition of the emulsion layer. I succeeded, however, without injuring the emulsion layer, in separating the film from the back of the underlying roll, to which, of course, the moist layer of gelatin was firmly stuck.

These preliminary experiments were made to discover the nature of the material before me, and also to find suitable and risk-free methods. My task was to rescue from the susceptible and valuable materials the traces of pictures which might possibly be concealed there, and to waken to life the seed sown one-third of a century ago.

The problem was to find a developer whose energy would be able to bring forward the hidden, latent pictures, without allowing the "veiling" tendency of the emulsion to predominate.

Several developers were tested in varying combination. The film was developed piece by piece, with varying results. When the work of development was ended, there had been obtained, from the 192 exposures contained in four rolls of films, fifty films, with more or less evident trace of pictures.

Of these, twenty were so clear that it seemed possible they might give re-

Breaking camp, July 22nd, 1897, preparatory to starting out in search of land after the balloon landed on the ice.

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producible pictures, after proper treatment.

About five-sixths of the film found in the roll cassette had been exposed to years of destructive action and light. The roll which, of course, was soaked through, had dried to some extent after being found, and had become one compact, stiff mass.

It was not until I had sawed off the ends—which, on drying, stuck fast—that it became possible to unroll the remaining central part, which was still damp. When developed, it was found that the innermost turns of the film really contained the pictures, which, although much damaged, were in some parts fairly clear, as is evidenced by the pictures reproduced here.

It has been established that the films used by Andrée were made by the Eastman Kodak Company, of Rochester, N. Y., and the fact that these films lay for so many years in the open that they almost perished entirely inspires a few words of admiration for the manufacturers. No less a tribute is due to Professor Hertzberg for his monumental work in extracting from the mutilated mass so many negatives as he did, thus preserving for all time invaluable visual records of the high courage and indomitable will with which the three adventurers bravely faced their inevitable fate.

It only remains to be said that they did not die in vain. Andrée's prophetic speculations have come true. We of a succeeding generation do not think he and his companions were mad. On the contrary, we have sent after them many successors, even into the air.

Closeup of Andrée's tent at the spot where the balloon landed on the ice

Make This Home Recording Outfit

(*Continued from page* 1007)

an equalizing transformer (such as the Amertran No. 389). A "scratch filter" may or may not be used and this can comprise a 1500 twin honey comb coil in series with a condenser of .008 m.f.

The secondary of the equalizing transformer passes the voice current into the primary of the first audio stage transformer as shown. The voice currents are amplified through this stage and pass into the second amplifier stage, which may be an ordinary single tube or else a push-pull arrangement. Good results have been obtained with an ordinary two-stage amplifier using a 201A type in the first stage and a 171A type in the second stage, with 180 volts on the plate. In the circuit the usual loud speaker, of the dynamic or other type, is connected to the terminals B and B1. The output transformer shown in Fig. 3 is not considered as one of the type where the secondary is of the low impedance type especially suited to feed into the voice coil of a dynamic speaker, but this transformer is supposed to be one of the general output type with high impedance secondary. In some of the writer's experiments no output transformer was used at all and the B plus and plate terminals from the output stage of the amplifier were connected directly to the magnetic pick-up.

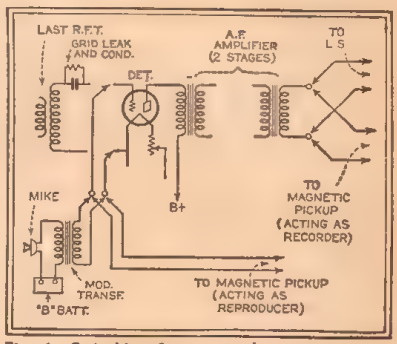


Fig. 4—Switching from recording to reproducing. Four connections must be alternately transposed.

Two different schemes for connecting the microphone to the imput of the first amplifier at the points A and A1 are given; in the second connection we have the potentiometer acting as a control of the volume and it also prevents blasting. Referring to the connection of the magnetic pick-up as a *recorder* as shown in the diagrams of reproducing circuits the pick-up is of fairly high impedance and is connected to the secondary terminals B and B1 of an output transformer such as the General Radio type. The output terminals

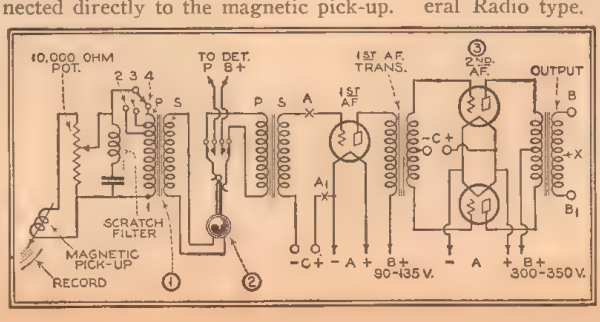
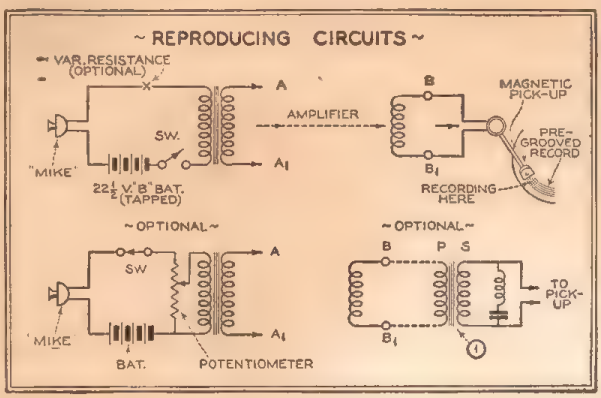


Fig. 3—Schematic drawing of possible reproducing circuits. In one instance a potentiometer is employed as a volume control and to prevent blasting. The use of an equalizing transformer — an Amertran No. 389—is also indicated.

B and B1 may be connected to the secondary of an equalizing transformer such as the Amertram No. 389 as is also indicated.

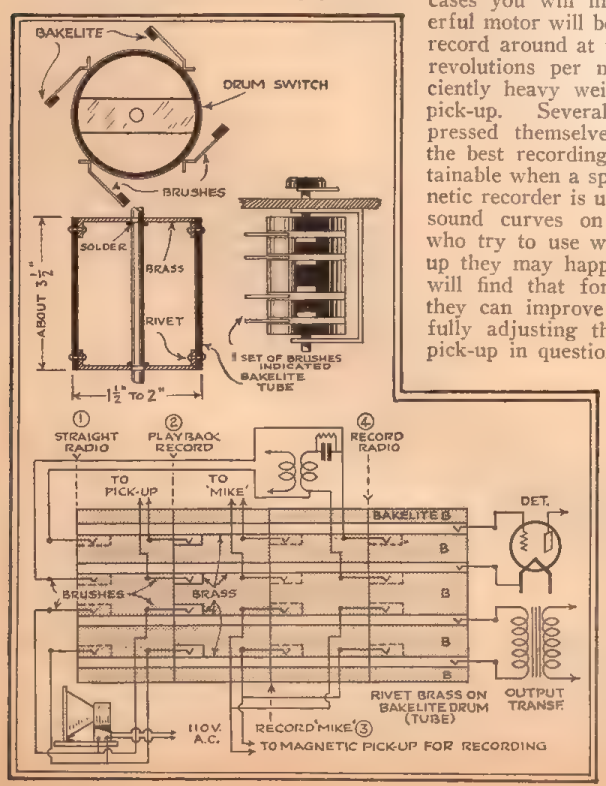
Fig. 4 shows how four connections are to be transposed alternately when switching from "recording" to "reproducing." First we have the microphone connected through a modulation transformer to the imput of the detector, with the magnetic pick-up connected to the output of the amplifier, the pick-up doing the recording in this case. Secondly, we have the pick-up connected to the imput of the detector and the greatly amplified pick-up currents emerging at the output terminals and passing into the loud speaker.



Schematic drawing of possible reproducing circuits. In one instance a potentiometer is employed as a volume control, and to prevent blasting. The use of an equalizing transformer — an Amertran No. 389, is also indicated.

The several combination phonograph and radio receiving sets now on the market which feature home recording, are provided with a special switch which by the simple movement of a knob does four things, viz., it provides straight radio; play-back from your record; microphone recording; and fourthly, radio recording.

In the drawing reproduced at Fig. 5 we see how a homemade switch of fairly simple design can accomplish all of these four things. This switch can be built in any desired form or style preferred by those who are familiar with electrical devices to a fair extent. The contact brushes may be made from spring brass, or better still phosphor bronze. The brass or copper contact strips on the drum and which are to rotate with it when the switch knob is turned, may be riveted with small rivets made from brass nails to the piece of bakelite tubing. The brushes are supported on bakelite or other insulating members in their four respective positions about the drum.



The latest radio receivers are equipped with a switch which will enable you to use the same instrument for four different purposes. By a turn of the knob you can have the usual radio entertainment, record your own features, record radio programs, and then play back the records you have made. Here is a flat drawing of a switch of this kind. Why not make your own?

How to Get Best Recordings

A few general remarks will no doubt be useful in conclusion. Best "recording" results are obtained when just the right weight is exerted by the pick-up on the pre-grooved record, and the extra weight of eight to fifteen ounces should be experimented with. In many cases you will find that a more powerful motor will be necessary to pull the record around at the usual speed of 70 revolutions per minute, when a sufficiently heavy weight is placed on the pick-up. Several experts have expressed themselves to the effect that the best recording results are only obtainable when a specially designed magnetic recorder is used for engraving the sound curves on the record. Those who try to use whatever electric pick-up they may happen to have available, will find that for *recording* purposes, they can improve the results by carefully adjusting the mechanism of the pick-up in question.

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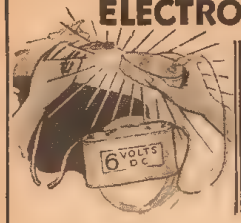

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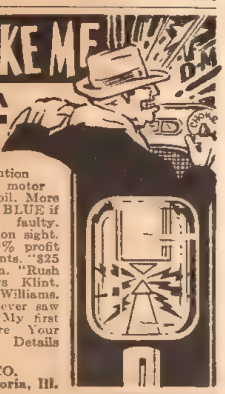

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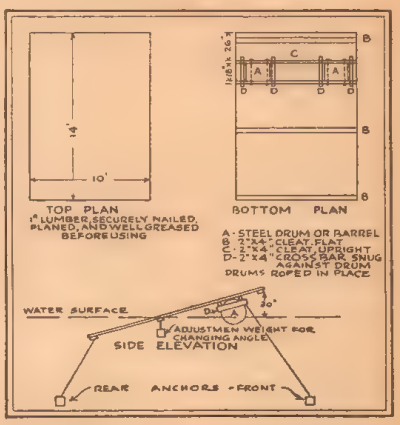
Some Outboard Stunts You Can Do

(*Continued from page* 981)

extended from the four ends of the platform in such a way as to hold it in place. The barrels are placed about three feet from one end, and this naturally elevates that end and submerges the other, and the trick is to put one or two additional weights on each side of the platform so that the submerged end is at least eighteen inches to two feet under water. Then you grease the center of the platform thoroughly with waste motor oil from a garage, and you are ready to jump.

"Loosen the bracket of the lower unit of your motor just a trifle so that it works easily, and drive directly at the center of the platform at a speed of approximately twenty-five to thirty m.p.h. Sit well forward over the steering wheel and hold on tight as you hit the platform. Don't bother to tilt the motor, as one of the reasons for the popularity of outboard motors is that old Evenrude, years ago, designed this tilting feature as a protection for the motor against sunken roots and rocks. While you are flying through the air the motor comes back to a vertical position, the skeg having protected the propellor against damage. The strain on the boat or motor seems to be no more than that encountered on hitting a large wave in a race. The thing to remember, however, is to remove the fin from the bottom of your boat before trying this."

Another startling stunt that made the aviation world as well as the boating world gasp was the flying of an aquaglider, an aquaplane over which a small wing is constructed. This aquaglider with only twenty-seven square feet of wing surface (about the size of a kitchen table) was actually photographed eight or ten feet in the air flying gracefully over the heads of interested onlookers sitting in a boat. Controls of any sort except the ordinary aquaplane bridle were lacking, and yet this little glider was diving so gracefully with just the equilibrium of the rider to balance it that such companies as the Curtiss Aeroplane Company and many famous individuals wrote in for advice on how to secure or make one like it. In the first place this glider actually did fly with Dick Pope riding it and Harrison Fraser with a fast Elto F motor towing it at 45 m.p.h., but the speed had to be so terrific before the takeoff occurred, and the landing was so erratic that the cameramen could not get near it for the picture. Since a picture was wanted, a jumping platform was put out on the lake and the aquaglider towed up to it at about 5 m.p.h. and Dick then swerved the aquaglider over and up on the platform which tilted the wings so that the aquaglider made a 40 foot flight through the air before coming down, and incidentally the glider swerved so much to one side that it passed over a boatload of spectators who were alongside.



Constructional details of a jumping platform for outboard motor boats.

Space will not permit me to give many of these stunts in detail, but such hair-raising entertainment can be easily staged by your local outboard club at very little expense and with comparative safety. Therefore, if you really want to try a lot of exciting acts to entertain the folks at your next regatta, write me and I'll gladly furnish diagrams and details of such apparent death-defying acts as the "Rolling Hydroplane" a boat that rolls completely over on its back while travelling at 45 m.p.h. (And believe me—this is a prize winner for thrills!)

Aqua-Tennis, Aqua Skee-Racing, Outboard Water Polo—A Thriller of the first degree, Outboard Relay Racing and many others are as flashy and entertaining. Next month we will tell you how to overhaul your outboard.

Lack of space need not prevent enthusiasts from holding an outboard race, as this photograph conclusively proves.

Science Pops Corn by Radio

(*Continued from page* 978)

tady to the luncheon meeting, so, instead, a strip of fluorescent screen material was subjected to a cathode-ray bombardment in the Schenectady laboratory. The material was then placed in a vacuum bottle containing liquid air, and in that condition carried to New York. When the screen was removed from the liquid air at the meeting, it could not be seen in the darkened room. But as it warmed up, it began to glow with a deep yellow tint. It became warmer, and the glow became purple. As it continued to warm up to room temperature it continued to glow in different hues, with waves of colors sweeping across the small screen in much the same way as the Northern Lights sweep across the sky on cold nights.

At a temperature of hundreds of degrees below zero, air exists as a liquid. It occupies much less space than does air as a gas, and must be kept in uncorked vacuum bottles so that it can boil off slowly.

The smallest voice in the world—that of the atom—was heard by the audience as a series of loud clicks. The atoms which spoke were those of uranium and one of the radium compounds, two of the rare substances that are radioactive and which constantly throw out electrons and so-called alpha particles, or helium ions, into space. This decomposition of the radioactive substance is spontaneous, and cannot be controlled in any way by scientists. The unstable atoms become another element, lead, after passing through several stages of decomposition.

The voice of the exploding atom was made audible by means of the Geiger apparatus. The alpha particles emitted by the radioactive substances enter an air chamber through a thin aluminum "window" before which the substance is held. The particles ionize, or make electrically conducting, the air within the chamber; and the current thereby produced is amplified sufficiently by the apparatus so that the effect of the explosion of the radioactive element is heard as a sharp click in a radio loud speaker.

Sound became visible and light became audible. On the lecture table was a portable phonograph with an electric pick-up. No sound was produced when the phonograph was started, but, instead, a neon lamp on the demonstration table glowed red. Mr. Manning walked toward the glowing red lamp with a wand, in the end of which was a photoelectric tube or electric eye. From the nearby loudspeaker music could be heard, louder as the wand was moved toward the neon light. By cutting off the amount of light with his fingers he controlled the volume of the sound.

Most vacuum tubes are of the high-vacuum variety, in that all possible gases have been removed from within them. Such tubes require high voltage circuits for operation.

There is a newer type of tube, called the Thyratron, which is adapted to most power purposes and which contains mercury vapor at low pressure. Such a tube can be employed with low voltages. This type of tube is in use in many kinds of control applications, for as a relay it is sensitive, is instantaneous in action, has no moving parts, and can control large amounts of power.

Mr. Manning lighted a match and held it in front of a photoelectric tube. A 1000-watt incandescent lamp was thereby lighted by means of a Thyratron tube which was connected with the photoelectric tube to serve as a switch for the lamp.

With this apparatus, as little as a ten-millionth of a watt can control a maximum output of ten thousand watts—an amplification of ten billion fold.

Try These in Your Own Workshop

(*Continued from page* 1011)

add another tool to your equipment, one for which you will surely have plenty of use. It's a scraper and can be very easily made. All you need is a length of piping, a T joint, a piece of hard wood and a steel blade. Almost any junk shop will supply you with the necessary materials for next to nothing. Or perhaps your own collection of odds and ends contains the parts you will need. In use, raising or lowering your hand will change the angle which the blade makes with the wood. The scraper can be converted from a pusher to a puller, or from a puller to a pusher, just as you wish, by merely turning the blade in the holder.

Even the best of chairs loosen up after a while, and eventually the rungs work out of the holes which hold them. Here is a good way to remedy this defect. Split the end of the rung a little as is usually done for the insertion of a wedge in a hammer handle. Cut a small wedge to fit this split of such size that it will spread the wood sufficiently to tighten the rung in the hole when driven home. Place the wedge a little ways in the split, and fill the hole with glue. Then drive the rung into the hole. It will be wedged tightly because as the wedge strikes the bottom of the hole it is forced further into the split, thus spreading the rung.

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City Post Office Clerks
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An Easily Made Plate Rack

By Wayne Sprecher

THE plate rack herein described was inspired by a picture in a Sunday rotogravure section of one in the kitchen of Washington's Mount Vernon home. The writer has endeavored to simplify the construction and, so far as possible, has employed materials to be found in any lumber yard.

Proper selection of material is essential if the article is to be stained and varnished. Therefore, in selecting the material pay particular attention to grain. Inasmuch as very little, if any, face planing will be required, the curlier the grain the better.

Material required is as follows:

No.	*Size.*	*Material.*
3 only	1″× 6″×12′0	B&B yellow pine;
1 "	1″× 6″× 8′0	" " " ;
1 "	3½″× 6′0	Ceiling moulding;
1 "	2½″× 6′0	" " " ;
2 "	¼″×¾″× 8′0	R Edge scr'n mld.;
4 "	¾″× 3′0	Hardwood dow'ls;
1 "	48″×48″× ¼″	Fir Panel;
1 "	18″×30″× ⅜″	" " " ;
2 "	½″× 3″	Angle Irons;
2 "	5″	Shelf Brackets;
48 "	1½″×⅛″	W'd Screws FH;

Small nails; glue; putty or plastic wood.

Before cutting the lumber see that three of the dinner plates you intend using in the rack will fit in the thirty-inch space allowed in the sketch. If not, allow for it, and begin cutting.

A practical and ornamental rack for dishes and books.

Cut the four uprights and the top and bottom from the 12's and the center shelves from the 8-foot piece. 1″ × 6″ actually measures, when bought dressed, ¾″ × 5¾″ and this has been taken into consideration in the drawings. After cutting to length, groove the uprights as shown for the shelving. Take particular care with the two inner uprights.

These two uprights are grooved on both faces—on the inner sides with ¾″ grooves, the outer sides with ⅜″ grooves, both sides being ¼″ deep. After grooving drill the ¾″ by ¼″ deep holes for the dowels at the center points as indicated in the sketch. Rabbit the back edge, top and bottom ends of the two end-uprights as shown; rip inner uprights, center shelves, top and bottom pieces to required width and plane smooth. Cut the plate grooves in center shelves, top and bottom pieces indicated, using ¼″ cutter and making two cuts—the first at about five degrees and the second at 45 degrees—for each groove. Cutting them this way will make them more adaptable to soup plates, bowls, and other pieces of china.

Now sand thoroughly all pieces, cut and assemble the inner uprights, center shelves, top and bottom pieces, end uprights, in the order named, using 1½″ × ⅛″ wood screws (flat bright) well counter-sunk.

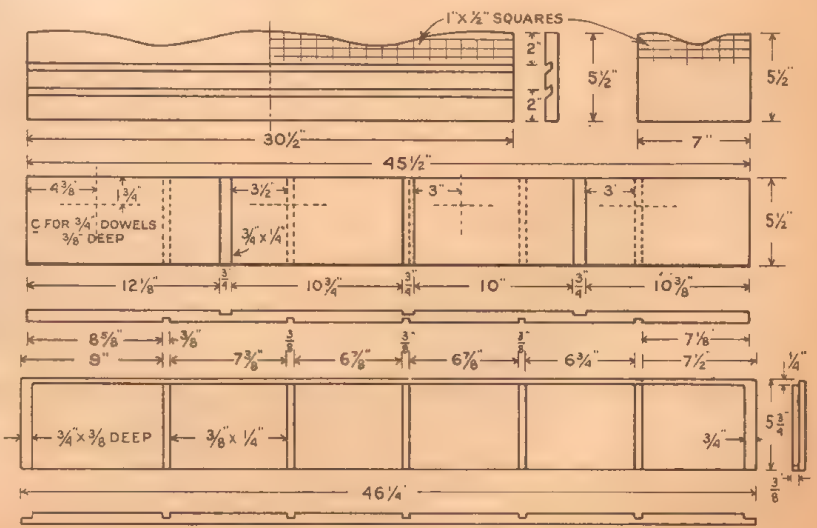


Diagram showing location of shelves (side view).

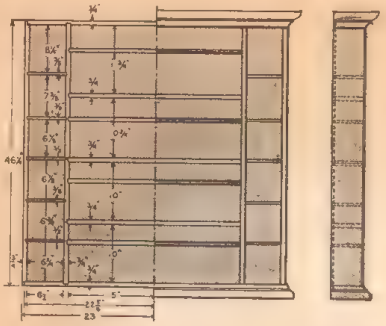
The ¾" dowels must be inserted with the center shelves during the assembly and may be secured against turning by putting a small drop of glue in the holes

The ceiling moulding must be put on next and care should be used in cutting the miters. It is much easier to cut these in a hand miter box than on a small table saw. Fit the 3½" to the top and the 2½" to the bottom of the assembly, using finishing nails and glue and, if desired, small angle irons on the inside for strength. Set the nails and sand carefully and thoroughly. Nail some temporary feet on the bottom to protect the moulding from being broken during the balance of the work.

Cut the ¼" fir panel to fit the rabbets in the end pieces and square with the top and bottom and sand it thoroughly but do not put it in place yet. Sand this piece to a beautiful, smooth finish with fine paper because the grain of the fir will, if properly brought out, do much to enhance the beauty of the finished work. The small shelves for the ends may now be cut, either square or with curved front edge, and sanded. Cut the screen mould to fit the front edges of the four uprights and sand. Now check over all the parts and sand everything to a fine finish.

All parts may now be stained, brown oak being preferable, because of the beautiful way in which it brings out curley pine and fir grain. Dry thoroughly and give a coat of thin shellac. Dry and sand lightly but completely. Give another coat of full cut orange shellac; dry; rub with steel wool (000). If necessary, give another coat of shellac the same way. Now either finish with spar varnish or clear lacquer. If varnish is used, finish with a ground pumice-and-water rub, followed by rottenstone and oil, rubbed on with a bit of chamois leather.

The clear lacquer finish is easier and far preferable if the home craftsman has a good spray; but it is almost impossible to do a good brush job over the shellac base. In spraying, use a good, clear lacquer, thinned to the proper consistency, and allow plenty of time—about four hours—to dry. It takes a little time, because the shellac loosens up some when the lacquer is sprayed over it. Rub with steel wool (000) and give a final coat of greatly thinned lacquer. After it is dry, rub down as above, which is the better finish; or polish to a high finish with lacquer polish. The rubbed finish is the more desirable, however. Particular care must be used in rubbing the mouldings so as not to cut through to the wood on the sharp corners.



Here is the data you will need to build this useful and decorative article.

The back panel may now be fastened in place, small nails being used and particular care given to driving them straight and in the right places. It is highly advisable to drill for them with a twist drill. Lines drawn across where the shelves come against the back side of the panel will help to prevent nails going through into the finished open spaces. Put the small end shelves in place and, finally, fasten the screen moulding in place over the front edges of the uprights, finished as the other parts were with stain, shellac, varnish or lacquer, and rubbed. Use small roundhead blue screws, brass roundhead or oval head screws, or brass escutcheon nails.

Attach the small angle irons to the top and the shelf brackets to the bottom with screws and mount on the wall. If mounted over a fireplace it may rest on the mantel and no lower brackets will be necessary, but use the top ones in any case to prevent tipping out from the wall.

The Safety Valve

(*Continued from page 966*)

Do you remember the Television department you used to have? I hope that you will bring it back also. You might entitle it "Television and Radiovision."

Several other publications have tinted pictures for their long articles. How about you?

JACK DARROW,
Chicago, Illinois.

(*Well, what have our readers to say?*—EDITOR.)

An Astounding Discovery

IF you are the least bit interested in making an astounding discovery, you will investigate the report from Lewistown, Idaho, December 25 1930, that a bright light passed with great speed through their skies, succeeded by a terrific crash. Don't hesitate but find out about it. It will likely astound everyone.

A FRIEND.

(*Has anyone anything to report on these supposed phenomena? We shall be glad to hear from our readers.*—EDITOR.)

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JOSEPH ZELKA,
Brookfield, Ill.

From Hopeless Poverty To Well-Paid Success!

Twins? No. Just two pictures of J. H. Huppert, of Beulah, Michigan. At the left is Huppert as he looked in the days when he believed that salesmen were "born"—and when he was tied to a $25-a-week job. On the right—the same Huppert, who now knows that he or any other man can *learn* successful salesmanship—and who, when he had learned, stepped into a job at $11,000 a year!

How Do You Know You Can't Sell?

HAVE you ever learned any of the real facts about salesmanship? Have you ever heard, from a successful master salesman, his methods which make his job easy? Then you *don't* really, know that you can't sell.

Many men have let themselves be cheated out of their biggest opportunities, because they thought they couldn't sell—because they were told, and believed, that successful salesmen were "born." Yet, when they actually found out the real secrets of selling, they realized that salesmanship is one thing which *must* be learned—which cannot be inborn—and which now, thanks to an amazing new training, is one of the easiest things to learn. They found out, too, that *trained* salesmanship is the highest-paid profession in the world.

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A new volume, "The Key To Master Salesmanship" is now presenting a graphic history of how the National Salesmen's Training Association has dispelled the old "I can't sell" idea for thousands of men, raised them to the ranks of highly successful salesmen. Not only that, it tells the method by which this is done. Today "The Key To Master Salesmanship" is being given away FREE to every man enough interested in his own chances for success to write for it. Send for it today, and learn from it, from the experiences of some of the most successful salesmen in the world. Mail the coupon now.

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Is the Earth Getting Warmer?

(*Continued from page* 991)

Ewing Galloway, N. Y.

This photograph shows clearly how the sharp peaks of mountains have been worn smooth by ancient glacier action. Note also wooded moraine at right.

on the great Freshfield Glacier in the Canadian Rockies. With a steel tape he measured the distance to this line from each of a row of fourteen numbered boulders, fifty paces apart, laid across the ice.

In 1926 he returned, found all but three of the boulders (which had doubtless fallen into crevasses), and found that while some had advanced a few feet farther than others, the entire mass of ice had advanced about 380 feet in the four years. Even in winter it moved about three inches daily. But despite this "flow" of nearly 100 feet a year, the glacier's snout had actually retreated about 330 feet. The rate of this retreat has increased in the last twenty-five years.

In other words, the glacier is steadily drying up. Thus either the supply of snow a century ago was deficient, or else the climate is warmer. If the latter is true, as many believe, all glaciers will eventually vanish. The great Nisqually Glacier on Mount Rainier, in Washington, has retreated 1,000 feet in 25 years. All of these frozen rivers, the greatest glacial system in this country, with icy tentacles up to 5.9 miles long, are steadily receding.

The 100 glaciers in Glacier National Park, and the 470 in Switzerland, covering 710 square miles, are generally retreating. Of nearly 2,000 Alpine glaciers, only a few are stationary or advancing. The great Aletsch, twelve miles long, which sweeps around the southern side of the Jungfrau, loses about thirty feet a year. Some retreat double as much. The recession is measured by a "cryocinemeter," which has a dial operated by a wire attached to the ice front, and makes a continuous automatic record.

Continental glaciers; — of which Greenland and Antarctica have the only survivors—profoundly affect world climate. From these icy wastes, a mile or more thick, many of our winds and storms originate. "Piedmont" glaciers, huge flat sheets which attain areas up to 1500 square miles, affect ocean temperatures and cause cold currents by discharging volleys of tremendous icebergs into rivers and bays The Malaspina sheet, Alaska, presents seventy miles of ice wall. The Miles and Childs glaciers have faces three miles wide and as high as a 25-story building.

Glaciologists sometimes find whole avalanches, 200-foot lakes, and boulders as big as houses being carried along by glaciers. When the frozen river falls over cliffs, ice cataracts and currents are formed. Crossing a glacier, with its open crevasses, towering "seracs" with sharp peaks twenty to fifty feet high, its treacherous snow bridges and slippery footing, provides thrills enough for any scientist At any moment he may find himself breathlessly dangling in thin, cold air, held to his party by only a rope, while icy fingers seem to draw him down into the freezing depths.

Several have actually broken through and dropped into one of nature's refrigerators. If soft snow is on the bottom, a lucky man may walk or climb out unharmed. Some have been injured, frozen and lost without hope of rescue. Often icy water collects in crevasses. Some years ago a photographer was seen to plunge forward into a crevasse in the Olympics, in Washington. Neither the crevasse nor his body were ever found. The body will probably emerge many years hence, as have the bodies of some who were lost in the Alps, often preserved most amazingly.

There are smoother stretches that become as slippery as glass. On one such spot a Swiss aviator recently landed with provisions for a French movie company; skis replaced the wheels, and deep crevasses marked the limits of this unique and hazardous landing field and motion picture setting.

After the Shot Is Fired

(*Continued from page 992*)

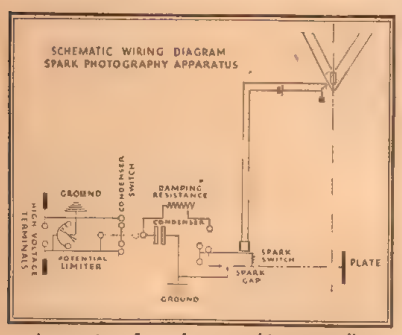
in ten thousand and even more accurately, if required, enables the velocities, primer ignitions and similar vital factors to be determined with an accuracy hitherto not approached.

By means of this ultramodern apparatus, representing as it does the utmost precision in equipment of its kind, we have been enabled to investigate not only our own product but that of others as well. In this manner it has been possible to establish standards of accuracy and functioning unbiased by personal opinion.

Spark photography, in which the illumination is provided by an electric spark of such short duration that even the most rapidly moving projectiles apyear stationary, has many applications in the ammunition industry.

There was a period in the history of small arms when it was considered that if the bullets were swaged and in addition possessed the requisite weight, bearing length, diameter and hardness that little more was to be desired. However, all of these factors may be quite correct and yet the most erratic results may be encountered if special care is not taken to insure a base as nearly symmetrical as it is possible to make it.

The region in the immediate vicinity of the muzzle is one of the most critical in the firing cycle of any arm. In this region the gas is still rushing past and pressing on the base of the bullet with tremendous force.



Apparatus for photographing rapidly moving objects.

If the base of the bullet is unsymmetrical in any way, either due to a lack of concentricity of the boat-tail portion, to deformations of appreciable magnitude, or other similar causes, there will be an unbalancing component acting on the base due to the gas pressure, which will suddenly tilt the bullet. This force is so great that entirely aside from its effect on the gyroscopic or spinning action of the bullet, even at a range of 30 yards, it will result in a surprising deflection, as can be strikingly demonstrated with bullets deformed as above. If care is taken to properly orient the bullets with respect to the deformation on the base they may be placed at the corners of a square at the target by simply turning each cartridge ninety degrees ahead of its predecessor in the breach.

The Peters .30-06 Hollow Point expanding bullet is loaded in one of the most deadly of the big game cartridges. In order to demonstrate the enormous stopping power of this cartridge a series of four instantaneous photographs were taken showing the bullet in various stages of penetrating a cake of paraffin four inches thick.

Fig. 4 shows the .30-06 Metal Case Hollow Point bullet roughly eight inches out from the emerging side of the paraffin cake. The lead slug and bullet jacket are seen just behind the "V"-shaped sound wave. The paraffin wax is thrown out from both sides of the cake but of course this effect is enormously greater on the emerging side.

One of the first phenomena which may be advantageously studied by means of spark photography is the preliminary leakage of gas before the bullet has even reached the muzzle.

There is no bullet with which some gas leakage does not occur, as can be seen from the puff of gas ahead of the bullet in Fig. 1. We sometimes receive letters from those whose training should enable them to know better, stating that gas leakage is an utter impossibility. Such individuals generally are of the impression that a jacketed bullet, such as the .30 caliber Springfield or the .45 Colt Automatic, would be a perfect obturator. A moment's consideration will convince the discerning individual that it is a most difficult matter to force metal into the corners of the rifling grooves so as to absolutely seal the bore. It is in fact quite impossible, at least at the present time, to prevent gas under such enormous pressure from blowing through the smallest opening.

The volume of leakage gas which appears as the bullet nears the muzzle is of course under considerable pressure; nevertheless its volume is several times that of the air in the barrel just before firing. Hence, if this leakage gas were permitted to expand until its pressure fell to that in the barrel before firing, it is obvious that the ratio would be still further increased.

By proper design it is possible to reduce such leakage to a minimum, but it cannot be absolutely prevented.

Fig. 1 illustrates a bullet roughly four inches out of the muzzle of a Colt's .45 caliber automatic pistol, a 1911 model. There is no evidence of the powder gas accelerating the bullet at this distance. Note that there has as yet been no appreciable upward movement of the muzzle. Such upward motion only occurs when the slide is arrested by the receiver and at this stage the bullet is several yards down the range. That is to say, other factors being equal, you will get a bull's-eye if you hold one and *no amount of so-called kick ever encountered in practice can cause you to miss.*

The photograph shown in Fig. 2 was taken of a 12-gauge full choke shotgun. The shot charge from a target shell is approximately 15 inches from the muzzle, and the components of the load are beginning to separate.

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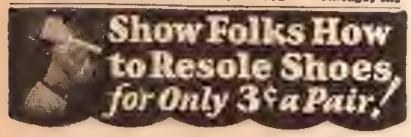

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In the March Issue of
AMAZING STORIES

THE THING THAT WALKED IN THE RAIN, by Otis Adelbert Kline. Although discussion on glands has passed the "parlor fad" period, the subject continues to be of enormous speculative interest to scientists who are interested particularly in endocrine and thyroid glands. Much has recently been established as fact in the field of possibilities, but the science of glands is still in its infancy and much can be expected in the near future.

THE VALLEY OF TITANS, by L. A. Eshbach. Many hundreds of our readers will welcome this scientific fiction gem, so reminiscent of Merritt, which goes once more, though in an ingeniously new way, into the possibilities of ruling intelligences that are not housed in what we know as the human body.

THE EARTH'S CANCER, by Capt. S. P. Meek, U.S.A. Our well-known author is obviously not immune to the all-prevalent interest abroad in the subject of this malignant disease. Far from being a medical treatise, Capt. Meek's offering is an absorbing tale based on the definite findings of our medico research friends.

TELEVISION HILL, by George McLociard. (A Serial in 2 parts) Part II. Here's a subject for competition! Will we travel to the moon and the other planets of our universe, or will we get our first-hand information first through television? "Television Hill" is extremely thought-provoking.

AND OTHER SCIENTIFIC FICTION.

Fig. 3 is a photograph of an unusual bullet. This spark photograph shows a .25-35 soft point bullet fired from a rifle whose barrel was 26 inches long and the pitch of whose rifling was one turn in 8 inches. The first 10 inches of the lands and grooves of the rifling of this arm were almost worn away and the bore was quite rusty. It had apparently been greatly abused when submitted for test. The muzzle speed of this bullet was approximately 2,000 feet per second and the point at which the photograph was taken was roughly 20 feet from the muzzle.

When such a bullet is fired under ordinary circumstances, from a rifle the barrel of which is in good condition, the lands, or raised portions of the rifling, are forced into the metal jacket as it leaves the mouth of the cartridge case. Thus, its rotational acceleration increases directly with its acceleration along the bore when the rifling is of constant pitch. However, in this case the bullet moved through the first 10 inches of the eroded portion of the barrel, in which the rifling was worn away, acquiring little if any rotational speed but a relatively great speed along the trajectory. Hence as the bullet entered the portion of the barrel in which the rifling still remained, the lands suddenly cut into its jacket and its rotation was violently accelerated, the shearing action being sufficient in this instance to puncture the bullet jacket. The heat thus generated together with that of the friction of the rusty bore was sufficient to melt at least a portion of the lead inside the metal jacket.

Due to centrifugal force, some of this molten lead issued from the aperture previously cut in the bullet jacket, in the form of a small stream. As this small jet of molten lead encountered the slip stream of the atmosphere through which it was passing, it was broken up into very minute particles each of which continued for a time to generate its own sound wave and wake as shown by the many parallel lines in the shaded portions of the bullet wake in the photograph.

Thus the bullet moved forward throwing out a finely divided spray of molten lead much in the manner of a pin-wheel moved in a direction at right angles to its plane of rotation.

The surface thus generated by this spiral spray of molten lead is not unlike that of a carpenter's auger or wood bit of which the bullet forms the point and the trace of the spiral spray of lead forms the body or twisted portion of the bit. The pitch of this spray is of course the same as that of the rifling, i. e., one turn in 8 inches.

The bullet itself does not follow the spiral of the lead spray, although it is probably forced to oscillate slightly about its trajectory due to the reaction of the lead spray which issues from the fractured jacket. The wake of the bullet immediately behind its base seems to bear this out. Due to the gyroscopic action of the bullet its instantaneous motion at a given point is not in the direction in which it is urged by the force due to the reaction of the lead spray but at ninety degrees to this direction. Thus the trace or wake of the lead spray should be not one hundred and eighty degrees from that of the bullet wake but only one-half this amount. The center of gravity of the bullet and spray system will trace out a smooth curve in space.

Approximately 4 feet farther along the trajectory from the point at which this spark photograph was taken, a sheet of paper was so placed that it was pierced by the bullet. A full-sized photograph of the original pattern of this particular bullet is reproduced on the photograph. It will be noted that the lead spray in the immediate vicinity of the bullet retained sufficient velocity to pierce the paper.

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Make a Stroboscope for Your Phonograph

By Paul R. Rannie

IF you would like to check the speed of your phonograph, cut out the disk shown in Fig. 1 and place it on the turntable. Illuminate it with a 60 cycle A.C. electric light. If the middle row of segments appears to be stationary, the speed is correct. If they appear to move in the direction of rotation, it is too fast, and if in the opposite direction, it is too slow. The other circles of segments will appear stationary at other speeds as indicated on the disk.

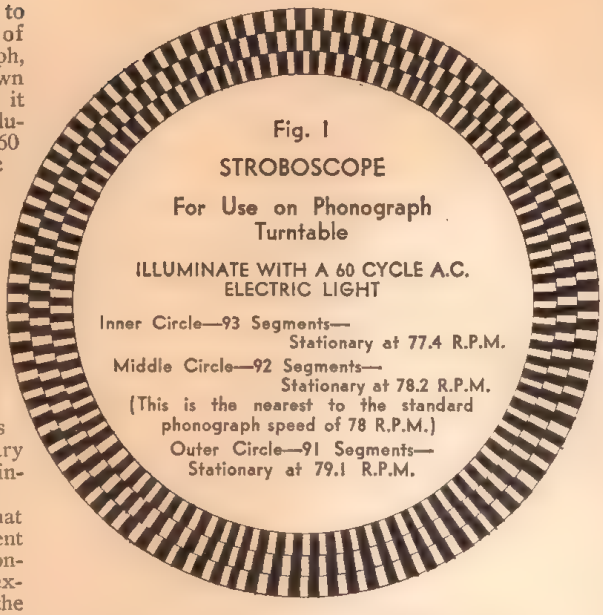
Fig. 1
STROBOSCOPE
For Use on Phonograph Turntable
ILLUMINATE WITH A 60 CYCLE A.C. ELECTRIC LIGHT
Inner Circle—93 Segments—
Stationary at 77.4 R.P.M.
Middle Circle—92 Segments—
Stationary at 78.2 R.P.M.
(This is the nearest to the standard phonograph speed of 78 R.P.M.)
Outer Circle—91 Segments—
Stationary at 79.1 R.P.M.

It will be noted that when the 92 segment circle appears stationary, the speed is not exactly 78 R.P.M., the standard phonograph speed. However, 78.2 is near enough for practical purposes and as near as it can be measured when using a 60 cycle source of light.

In some localities 25 or 50 cycles alternating current is used for illumination. Of course, the 60 cycle disk can not be used under those conditions. Fig. 2 shows an adjustable stroboscopic disk which can be used where only such frequencies are available. Cut out and adjust as indicated. For 50 cycles adjust to 77 segments and for 25 cycles adjust to 38 segments.

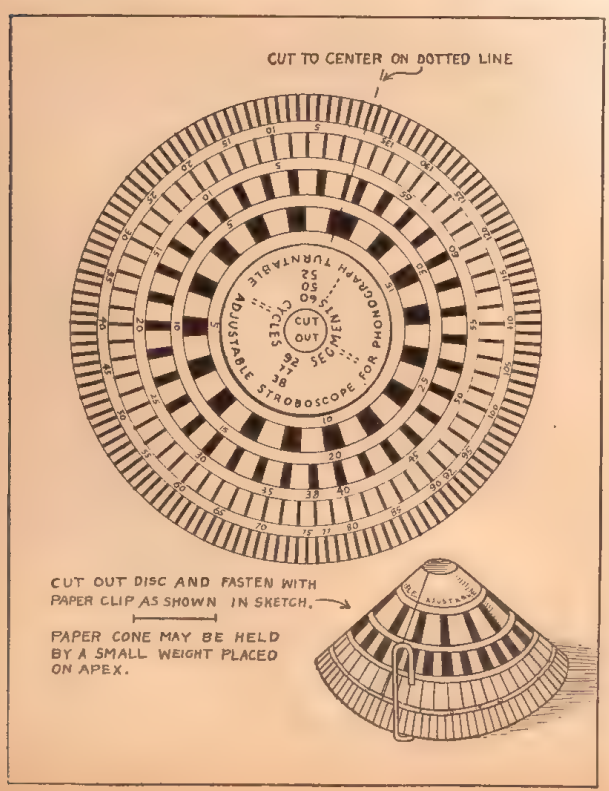
CUT TO CENTER ON DOTTED LINE
ADJUSTABLE STROBOSCOPE FOR PHONOGRAPH TURNTABLE
CUT OUT
SEGMENTS
CYCLES
CUT OUT DISC AND FASTEN WITH PAPER CLIP AS SHOWN IN SKETCH.
PAPER CONE MAY BE HELD BY A SMALL WEIGHT PLACED ON APEX.

Fig. 2—An adjustable stroboscope for use where only 25 or 50 cycle A.C. is available.

Fig. 3 gives curves which show the relation between the number of segments and the R.P.M. for the three standard frequencies.

The calculation of the number of segments needed for a given number of R.P.M.; or the number of R.P.M. corresponding to a given number of segments is very simple. First we must determine the number of flickers per minute of the light which is to be used. This is 2 times the number of cycles per minute because there are two flickers of

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IN RADIO NEWS *for March*

As a follow up on the exceedingly interesting article by Dr. James Robinson in the February issue of RADIO NEWS, in which technical details of the Stenode receiver were fully described, this month's RADIO NEWS contains a highly important series of technical discussions by prominent engineers in the radio field. This article also includes publication for the first time of fidelity and selectivity curves which bear out in a most conclusive way the claims made of the Stenode Radiostat by its inventor, Dr. James Robinson.

Joseph I. Heller, well known to RADIO NEWS readers, describes how to build a simple recorder for home talking movies.

For the benefit of amateurs, experimenters and servicemen, Mr. James Marin in another of his illuminating articles, tells all about frequency meters and frequency measurements.

Zeh Bouck concludes his vivid description of the flight of the radio equipped airplane "Pilot Radio" over two continents.

The full description of the radio equipment aboard the giant air liner, DO-X.

Beryl B. Bryant, Technical Editor of RADIO NEWS, has constructed what is probably one of the smallest six-tube superheterodynes in existence in his story entitled "How to Build the Mighty Mite." This receiver employs the dynatron oscillator producing exceptional fine selectivity.

Lieut. Com. William Justice Lee in an exclusive article, especially prepared for RADIO NEWS readers, tells about the Navy's work in setting up the Naval Volunteer Communications Reserve, an organization composed strictly of amateur operators for service in time of National emergency.

the light per cycle. For 60 cycles the number is 7200; for 50 cycles, 6000; for 25 cycles, 3000.

We shall use 60 cycles for an illustration. If I have a 92 segment disk, this figure is divided into 7200. The result is 78.2, which is the number of R.P.M. at which the segments appear stationary. If a speed of 72 R.P.M. is required, divide that figure into 7200 and the result is 100, or the number of segments to be placed on the disk. If the figure is not an even number, the nearest whole number is used to determine the number of segments.

The general rule is: Divide the number of flickers per minute by the segments to get the R.P.M. or if the number of segments is desired, divide the flickers per minute by the R.P.M.

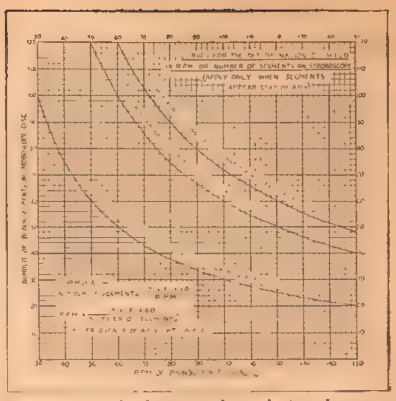


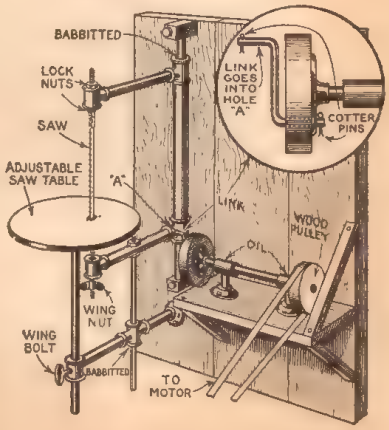
Fig. 3—Graph showing the relation between the number of segments and the R. P. M. for the three standard frequencies.

Jig Saw from Pipe Fittings

All You Need Is Space, Time and Second-Hand Pipe Fittings to Build This Tool

By R. S. Glover

A STRONG, durable and accurate jig saw can be made from used pipe fittings. And if reasonable care is taken in assembling and babbiting the parts this tool will give long and satisfactory service to its builder.



How the completed saw should look.

The dimensions are determined by first deciding the length of saw to be used and working out the height from this figure. Next, the size of fittings available determines its size. As the saw can be turned in its frame, to the right or left, permitting the working of long stock, a fourteen-inch radius is sufficient for the small shop. To turn the saw loosen the lock nuts which hold it in position.

The upper adjustable bolt is slightly bent as shown and two notches cut. As will be seen, this slight tilt to the saw enables it to clear the wood on the up stroke, which prevents chattering of the work so common with jig saws. The upper notch holds the saw vertical.

A hole is bored (not babbitted) in the T of the lower main bearing for one end of the link, the other end passes through a hardwood pulley and then through one of the four holes in the pipe flange on the shaft of the cranking unit. It is drilled at both ends for cotter pins.

The cranking unit should make from 250 to 300 revolutions per minute. And to avoid using a large, bulky pulley it may be driven from a countershaft.

By using a hack saw blade time and labor can be saved where only a rough cut is wanted on metal. Lower speed should be used with the hack saw than with the jig saw on wood.

Tool Contest Announcement

We deeply regret that the vast number of entries in the SCIENCE AND INVENTION Ideal Home Workshop Contest precludes the possibility of announcing the prize winners of this contest in the April issue of this publication, as we had hoped to do.

The verdict of the judges will be rendered in the May issue, so watch for that number.

If you have in mind equipping a shop for $50.00, $200.00 or $400.00, the prize winners will show you how to get the most complete and the best equipment for your money.

Banishing Rust from Our Tools

(*Continued from page* 1014)

provide hooks so that they may be submerged in the plating solution. Do not use copper or galvanized wire.

The anodes or "sticks" are hung about 1½" to 2" apart. The anode rod and iron connecting wire must be brightened with emery cloth so that proper electrical contact is made.

The chemicals for the plating solution, compounded as per formula which follows, may be purchased at any chemical or platers' supply house.

Cadmium Oxide	6 oz.
Sodium Cyanide	15 oz.
Sodium Sulphate	7 oz.
Molasses	¾ oz.

To these compounds distilled water is added to make a total volume of 1 gallon.

Measure the plating tank, determine the contents in cubic inches, and divide by 231 cubic inches to ascertain its capacity in gallons., The plating fluid may be brought up to within an inch or two of the tank top. The proper amount of chemicals may then be purchased for one filling of the tank.

Remember that the cyanide, and the solution, is of a deadly poisonous character. *Do not get any solution into cuts, eyes or the mouth.* Wash the hands thoroughly each time when through plating. Thousands of tons of various cyanides are used in many industries and ordinary precaution offsets the highly poisonous character, so that it is not feared.

Plating Bath Preparation

To prepare the plating bath pour in about half the amount of water. Have the water warm, about 130 degrees F. Add the cyanide and stir until dissolved, then put in the cadmium oxide and likewise stir until dissolved. Then add the sulphate and molasses, and pour in enough cold water to bring the solution to the desired volume.

By having a mark on the vessel to determine the volume desired, the remainder of the water may be added until the mark is reached. Bear in mind that the water *plus* the chemicals must produce a volume, as per formula, of certain density. Do not measure out a gallon of water and add the chemicals to it, for its volume will exceed one gallon.

The solution is stirred until all the chemicals are dissolved, then it is allowed to stand for a while, so that any sediment can settle out.

The electrical connections are shown in the drawing, it being best if a voltmeter, ammeter and rheostat be used for the control of the process, although it is possible to plate without using either voltmeter or ammeter.

The article to be plated is first cleaned of any welding or mill scale, paint or rust by the use of a fine file, wire brush and emery cloth. Finish off any rough spots.

Remember that the rust proofing or coating will take only on clean bright metal. When the article is thoroughly bright, all over, in every crevice, hole and thread, take a piece of soft bare copper wire about No. 18, and secure its end by twisting to some convenient place. As soon as the wire, which serves as a hanger, is attached, the article is ready to go through the process and it must not be touched by the hands or come in contact with any object until it has been plated.

10 to 30 Amperes per Sq. Foot

Then immerse the article in a boiling solution of alkali (such as caustic soda, 4 oz. per gallon of water) and allow it to remain for about 5 minutes so that all dirt and grease is removed. Let the wire pigtail or hanger hang out over the side of the vessel, and when the article is thought to be boiled clean, remove by means of the pigtail and rinse thoroughly in hot water, then in cold water, then immerse in a cold acid pickle (consisting of a 10 per cent solution of muriatic acid) for about one minute. It is then removed, rinsed in cold water, dipped into a cold cyanide solution (4 oz. sodium cyanide per gal.) removed and immediately hung in the plating bath, suspended from the middle or cathode rod. The current must be on as the article is immersed.

The plating solution is operated at normal room temperature, and, unlike some other plating solutions, does not have to be heated and maintained within close temperature limits. The voltage required will vary between 1½ volts for small pieces up to 5 volts for the larger sections. The amperage may be regulated to suit the pieces, varying from 10 to 30 amperes per square foot of surface. A point to bear in mind is the fact that a sheet of one square foot has two square feet of surface, since it has two surfaces of one square foot each.

A little experience will show the proper amount of current required and adjustment of the rheostat will give the correct intensity. The proper regulation is usually that which causes tiny gas bubbles to rise from the article in a slow, steady stream. Too much current, productive of copious gas evolution, results in a dull plate, with blackened edges. Proper current produces a clean, even, thoroughly pleasing rust-proof coating. A few trials and fifteen minutes experimenting will suffice to teach the novice to produce good coatings.

As soon as the article is removed from the plating bath it must be rinsed in hot water and dried with a cloth or in hot sawdust. A micrometer will indicate the thickness of the plating on the two surfaces.

The time of plating will vary with the current supply, but as a general rule it will be between 10 and 25 minutes.

The salt spray test is the criterion of plating resistivity and cadmium offers

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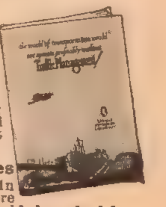

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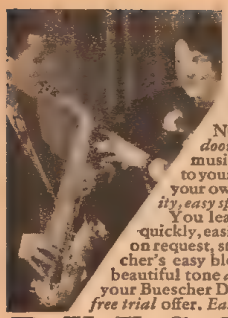

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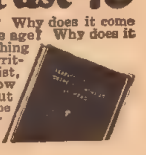

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A thickness of .0005″ offers a genuine rustproof plate, being equal to the resistance offered by a .025″ thickness of zinc, while the .001″ thickness is advocated for marine use where weight is of no concern and abrasion occurs.

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To replate damaged fittings, first clean in benzine or gasoline and then brush with soap and hot water, rinse in hot and cold water, dip into the cyanide bath and then plate directly over the old coat. The new coat will adhere firmly to the old coat, with such tenacity that it will not peel or tear away from it.

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of fire reaches it and simultaneously releases a pint of flame-smothering carbon tetrachloride. Ordinarily, one of these extinguishers amply protects a thousand cubic feet of space. We think that their installation is worth while.

You Can Use a Lathe

Home workshops are sometimes very complete and sometimes very unpretentious. Your particular equipment may center about a screwdriver and a pair of pliers. Eventually, no doubt you intend to acquire a complete set of tools. No matter what other equipment you have on hand, you should have a lathe, because with it you will find that you will be able to undertake and finish a good deal of the more complicated work. The one we have illustrated here can be furnished with attachments which will enable you to do sawing, grinding, buffing and scratching, besides the usual woodturning. If you will refer to the article "Metal Turning on a Wood Lathe," appearing in this issue, you will note that even metals can be fashioned on a machine of this type.

As temporarily set up in our laboratory.

Exercise Through Vibration

For those of us who prefer that stimulating vibratory effect which only an efficient electric machine can produce, we recommend the exerciser featured above. To call it portable is only telling half of the story. Not only can this light-weight machine be easily carried from one room to another but all you need to install it is an available doorway. Open the door, clamp on your exerciser, close the door and you are ready to switch on the current and get the benefit of this really excellent machine.

Scientific Book Reviews

PHYSIQUE AND INTELLECT, by Donald G. Patterson, Published by the Century Company, New York, N. Y. Page XXVII, 304, Indexed. Price $2.50.

Popular misconception has long assigned a distinct correlation of physique and intellect. Every movie comedy features the infant prodigy as a spindle-legged, poorly nourished, under-developed, eye-glassed youngster. Opposed is the brawny clear-faced, smiling, good natured, class athlete, who finds it almost impossible to make good at school.

Even our trained investigators are so accustomed to think along these lines that results of their researches are not trustworthy – not because they are biased, but because they have unconsciously allowed themselves to be influenced in the direction of the conclusions which they would like to announce. Patterson analyzes what other sociologists consider to be convincing data, which, pointed definitely to a distinct relationship between physique and intellect, and shows that the methods of gathering the deciding information and the standards which the workers accepted, were in each case faulty and unscientific.

We might best allow the author to present his conclusions himself. "Our detailed survey of available quantitative evidence has demonstrated that prevalent notions regarding the intimacy of the relationship between physical traits and intellect have been greatly exaggerated. Search in the realm of gross anatomy for a physical correlate of intellect has yielded uniformly negative results. It appears that such structural characteristics as height and weight are correlated only slightly with intelligence, narrowly defined. . . ."

"The findings clearly support the theory of *unique traits* as formulated by Thorndike, Kelly, Toop, Hull, and others. In brief, the theory of unique traits is that personality adjustments reflect, in variating proportions, the operation of relatively independent traits. In the Minnesota Mechanical Ability investigations, it was demonstrated I. Q., Mechanical Ability and Physical Agility are unique each with respect to the other. In other words, these three aspects of behavior, when isolated and measured with a high degree of reliability were found to yield low intercorrelations, so low in fact as to warrant to a degree acceptance of the theory of unique traits."

MACHINE SHOP WORK, by Turner & Perrigo, Revised by Fairfield. Published by the American Technical Society, Chicago, Illinois, 407 pages. Index. Price $2.50.

Usually literature, especially a text which can hold the interest of one who is conversant with the subject, is too involved for the comprehension and use of the beginner. Conversely, the book which is plain and clear to the novice is often thrown aside by the more experienced because it is too simple.

After this, it seems paradoxical to state that here is a book devoted to machine shop practice which will receive a warm welcome from both apprentice and master craftsman. Methods, tools to be used and care of these tools is described in detail. From a discussion on the use of the simplest straight edge for measuring purposes, we pass on eventually to a study of a slide rule. Quite early we are initiated into the technique of handling a file and informed of the nature and purpose of various types of drills. Further, we learn all about multi-spindle, motor driven, drillers and turret lathes which will automatically perform six different operations.

Throughout the entire text, a practical viewpoint is maintained. All points are clearly made and illustrated by photos or diagrams. This work is not theoretical—it tells you what to do and how to do it.

THE MYSTERIOUS UNIVERSE. by Sir James Jeans. Decorations by Walter T. Murch. Published by the Macmillan Company, New York, N. Y. Pages VII, 163. Price $2.25.

Most of the theories advanced by scientists are attempts to show that man is of no importance in this universe of ours, and that his existence is an accidental, momentary, fleeting thing totally devoid of meaning or purpose. Extensions of these hypotheses usually contain some allusion to man's ephemeral characteristics, the fact that all our efforts are futile, that our destinies and futures are in the hands of a relentless power, that our greatest works, no matter how substantial and solid will crumple into dust, and that while we struggle among ourselves in this sand pit of the universe, merciless, eventual, mechanical forces are surely bringing about our inescapable doom and destruction.

And now, like a ray of light, Sir James Jeans voices a comparatively cheerful and light-hearted hypothesis. He prepares us for his philosophy by first reviewing the more important latter-day discoveries and theories. Then we read that the universe, the handiwork of the Great Mathematician is no more or less than an abstraction, best expressed as a mathematical formula. Far from feeling that we are mere puppets approaching our fate as railroad trains run along tracks, regrettable by-products of some complex action, he tells us:

"Mind no long appears as an accidental intruder into the realm of matter; we are beginning to suspect that we ought rather to hail it as the creator and governor of the realm of matter—not, of course, our individual minds, but the mind in which the atoms out of which our individual minds have grown exist as thoughts. The new knowledge compels us to revise our hasty first impressions that we had stumbled into a universe which either did not concern itself with life or was actually hostile to life. . . .

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evidence of a designing or controlling power that has something in common with our own individual minds."

AMBER TO AMPERES, by Ernest Greenwood, Published by Harper & Bros., New York, N. Y. Pages VII. 332. Price $4.00.

Mr. Greenwood has chosen for discussion a rather broad field, the story of electricity—its discovery and development. We were not at all surprised to note that although he has done all that could be expected, he has most assuredly not written all that could be desired.

In the course of his work he answers the questions where and when, practically without exception—why usually—but we're very sorry to say that he hardly ever deigns to inform us how. And how is important.

Mr. Greenwood is an engaging guide. He leads us carefully through strange lands, takes us through mysterious mazes, helps us ford dangerous streams, brings us over hazardous trails to the mountains, bids us follow him to the peaks. Then suddenly we find ourselves on the cliffside gazing down into a vast abyss. Way far ahead of us is Mr. Greenwood, at the foot of another huge mountain, ready to climb the next hill—how did he get there?

In all fairness, it must be said that the easy flowing style in which the book is written gives us a very thorough, interesting picture of the epoch-making events which Mr. Greenwood discusses. The customs, needs, desires, and aspirations of the respective era in which the developments were made are very amply described. The younger matter-of-fact generation which takes everything for granted will appreciate conveniences and comforts a great deal more after reading "Amber to Amperes."

HOUSE WIRING, by Thomas W. Poppe—Revised by Harold P. Strand. Published by the Norman W. Henley Publishing Company, New York, N. Y., pages IX, 224 Indexed. Price $1.00.

Here is a small handy book, flexibly bound, so that it can be conveniently and comfortably stowed away in your back pocket or jacket. It is profusely illustrated, well written, and covers in detail practically all the problems which confront the electrician who is doing a house wiring job—be it renovation or a complete installation in a new building. The book tells you how to do your work and why you should do it in the manner suggested—need we say more?

Reviewed books can be obtained from the Publishers or through Our Book Department.

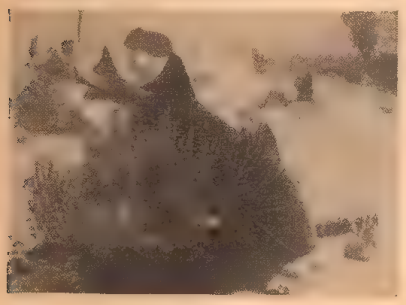
Cleaning Rugs

RUGS are greatly improved by cleaning them with cornmeal and gasoline. The gasoline is added to cornmeal until a wet mixture is obtained. A flat-top brush is dipped in this mixture and applied to the entire surface of the rug. —*H. E. Chrisman.*

My Adventures on the Ocean Floor

(*Continued from page 975*)

slanting now as evening comes, creating amazing changes. The seven colors of the rainbow play over the scene. Lifting such beauty as this in motion through the camera to the screen, has



This photo proves that a shark does not need to turn over to bite.

proven a source of delight to the millions who have seen my pictures from the jungles of the sea. But to capture it wholly in natural color photography has been the happy result of my recent work (the first in history) to project in magical colors actual motion pictures from under the sea.

The fading light dissolves this scene of nature's handiwork. I'll draw the curtain and close it off, as we go up to the surface with happy memories of your trip with me along the floor of the ocean.

With this rig, samples of coral were raised to the surface.

Answers and Prize Awards ir December Puzzle Contest

First Prize, of $10, is awarded to:
G. G. Williamson, 4333 No. 36th Street, San Diego, Cal.

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Then ten prizes, of one dollar each, are awarded the following:

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H. F. Norris, 2431 E Street, N. W., Apt. 1, Washington, D. C.

A. J. Simons, Eeles's Cottage, Brughclere, Newbury, England.

Norman W. Cote, 4 Grove Street, Waterbury, Conn.

Walter Smolak, 6160 Reedland St., Philadelphia, Pa.

L. G. Cabrere, R. F. D. 1, Box 275, El Paso, Texas.

W. Bowman Thrall, Superintendent La Roche Township High School, Academy, S. D.

M. Woffinden, Pioche, Nev.

Stewart Huey, 100 Ridgefield Ave., Waterbury, Conn.

Edwin R. Shaw, 506 Lyon St., N. E., Grand Rapids, Mich.

Solution to "Red Man Psychology"

The connecting link between the weights is, that one pound avoirdupois weighs 7,000 grains, while the troy, or apothecaries' pound, weighs only 5,760 grains. Thus, 175 pounds troy weighs the same as 144 pounds avoirdupois. That is the smallest quantity to register a whole number of pounds on either scales. On that amount, Big Elk's rebate would be $3.10.

Since it was told that the rebate was for less than five dollars, and the next multiple would make the rebate $6.20, it is established that the Elk was in the habit of buying 144 avoirdupois pounds of salt.

Solution to "The Peripatetic Pedagogue"

In going from his house to the school the professor had the choice of 70 different routes, and, of course, the same number for his return. Therefore, 70 times 70, or 4,900, is the maximum number of round trips, no two of which are exactly alike. Since it was asked how many additional trips could be taken without exactly retracing his original route, the answer is 4,899.

In the 8-block stroll from the northwest corner to the southeast corner, four of the block-long moves would be south and four would be east. Therefore we must calculate the permutation possibilities of eight terms taken in two groups of four each. Mathematically this would be:

$$\frac{1.2.3.4.5.6.7.8}{(1.2.3.4)\ (1.2.3.4)} \text{ equals } 70$$

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(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

Photographing Invisible Animals

(*Continued from page* 1004)

part of the bellows, which have an opening of the same diameter of the microscopic eye-piece, is arranged to slide up and down. Motion may be imparted either by a friction grasp or by means of rack and gear. The former is used if wooden strips are employed, the latter if toy construction parts are used. Naturally smoother working of parts is obtained in the latter case.

Attached to the lower opening of the bellows is a short tubular piece or sleeve of black cloth, about three inches in length, over which a small rubber band is passed. This slips over the eye-piece of the microscope; the rubber holds the cloth tightly about the eye-piece and so prevents stray light from entering the bellows. The film holder is placed on top of the bellows or box and fits snugly, but not too tightly. Focusing is accomplished by a ground glass, as has already been mentioned.

Now for the light source. As can be seen, the microscope is raised about six inches above the base of the stand. This permits the light below to be adjusted for all conditions. At times it must be at a distance from the microscopic stage, at others, quite close to it. This is easily accomplished by using an automobile headlight bulb. A 21 candle power bulb will do, although a more intense illumination can be obtained by using a 45 candle one. These can be obtained in all larger auto supply stores. The current can be either a storage battery or, if alternating current is available, a stepdown toy transformer.

The bulb is placed in an automobile lamp socket. A socket can be purchased in the place where the bulbs are procured. This is attached to a small frame, which can be moved foreward and backward by means of rackstrip and gear. The frame is firmly fastened to a second frame, which provides motion to the right or to the left. A third frame is made to carry the other two frames up and down. Motion of the lamp permits one to center the light for maximum illumination.

With such illumination it is quite possible to take pictures, under low power, almost as fast as snap-shots. This is, of course, of great value in taking living microscopic objects, especially slow moving plants and animals. Rapid motion should be avoided by paralyzing the organism, thus slowing down its motion. The chemicals to be used for this purpose are varied and numerous, each particular species reacting differently to various stimuli.

New Tools You Can Make

(*Continued from page* 1012)

Fig. 3, are not available, the tool might be built for wall mounting. Simply purchase a three foot length of channel iron, and at its upper end, mount a motor on two heavy iron angles, with its pulley facing the channel iron. In either case, the machine is built the same way.

Remove the pulleys and spindles from both heads, enlarge the two existing mounting holes in each base, and drill two more in the undrilled sides of both. Lay the polishing heads on the channel iron in their respective positions, and slip a long ½ inch drill rod through the four journal bearing holes. Then tighten all the four bearing take-up screws firmly, and clamp the polishing head bases tightly to the channel iron.

Very carefully and accurately scribe the positions of all eight base holes, unclamp the bases from the channel iron, but do not loosen the drill rod nor disturb the alignment of the set-up. Now drill to base hole size, only the four holes which fall on a center line through the channel iron, and drill the four outer holes slightly undersize. Replace the complete set-up on the standard, insert bolts only in the center holes, and tighten them firmly using lock washers under the nuts. Drill through base and standard, the four remaining outer holes to a size that will barely permit four more bolts to be forced through. Tighten them in place and the machine is half built.

The drill rod used to line up the heads may now be sawed to form the live spindle and table support spindle. A chuck of the geared key type is recommended for the live spindle because of its accuracy and because it may be easily removed for use on another machine. At the cost of about two dollars, any machinist will taper the live spindle to take the chuck and also saw a key-way slot lengthwise along both live spindle and table spindle. Also have a 60 degree center point turned on one end of the lower spindle rod.

The live spindle is mounted with spring, washers, collars and lever approximately as in Fig. 3. The lower spindle may also serve a function not apparent in this illustration as a drill press. The table with which it is shown mounted, is constructed of ¼ inch sheet steel, flat riveted to the face of a 3 inch pulley having a ½ inch hole. However, the press may also be used as a lathe for filing, grinding, polishing, by a few additional operations. Simply tap the upper hole in the bottom polishing head, and insert a machine screw whose end will engage the slot in the spindle. By removing the table from the spindle, and exposing the 60 degrees point, a dead center is ready for use. As for the live spindle, a collar must be set-screwed immediately behind the chuck, which, together with a brass washer will take care of the end thrust at this point.

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Leathercraft—A Fascinating Hobby

(*Continued from page* 1003)

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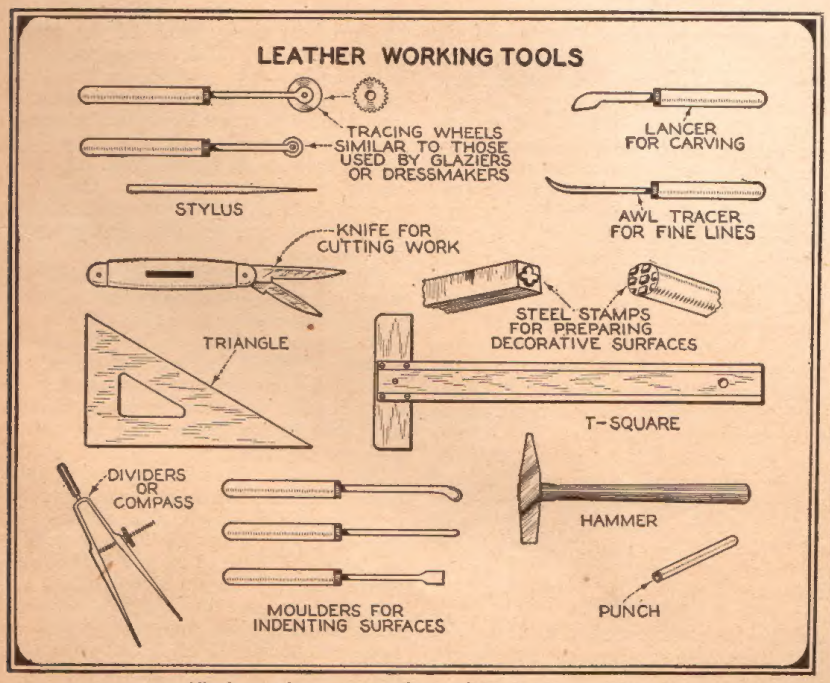
Calfskin is best for fine work. It is supple, and tools and stains well. It is procurable in varied thicknesses and in sizes of from eight to twelve square feet. Cowhide may be of dull or glossy finish; dull skins are especially suitable for staining. Cowhide is most suited to decorative work of bold character. Oxhide has about the same qualities as cowhide, but is stronger. Sheepskin is cheap, but stretches easily and much; it is suitable chiefly for practice work. Pigskin tools with difficulty, but is adaptable to bookbinding and the manufacture of bags, wallets, and the like.

Flat modeling, embossing, modeling on plastic paste, cutting or incising, and carving are forms of leatherwork requiring a minimum of tools, and simple in principle. Hence they are most suitable for amateur work. For all classes of work, the leather is prepared by soaking in water for about 24 hours in advance of use. If it is too dry for easy handling when the time comes for using it, it should be moistened with a sponge before work begins. If the leather is mounted on a wooden board, such as a drawing board, it should be stretched firmly over the board and fastened with thumbtacks or their equivalent. If a slab of glass is used for a working surface, the leather generally will adhere sufficiently without mechanical means of fastening, if properly moistened on its under side.

instrument convenient to hand. The preliminary design may be made first on paper and transferred either by carbon paper or by impress with one of the hard-pointed tools mentioned above, or it may be drawn directly on the leathern surface with a pencil or other marker.

The design having been completed, the surface around the design, and within the design where desired, is forced into the background with a tool, or with tools, no less simple in character than that employed in outlining the pattern. A small screwdriver—an awl, the point of which has been squared or rounded to suit—a small wood-chisel—any or all of a number of common tools may be pressed into service for moulding or indenting the leather surface. There are procurable any number of special instruments for use in this phase of leathercraft, but the amateur will do well to refrain from buying them until he has set himself a problem or two in design, and has seen what he can accomplish with tools available at any five-and-ten-cent store. In all ordinary circumstances he will find that the problem itself will suggest what common tools may be applied outright or improvised for the job. Most of the special leathercraft tools can be bought in large hardware stores, or in art shops and stationery stores.

When the background has been pressed down, it may be advisable to place it more forcibly at its new level by the use of hammer and punch, for which a



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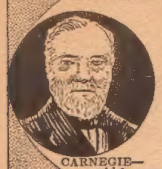

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traced with a design as before, but the design is also traced on the reverse side of the leather by means of a carbon paper, laid beneath the piece with its coated side upward. When the design is complete, the operator raises the leather and presses from beneath against those parts of the design he wishes to emphasize, elevating them above the surface. A ball-pointed tool should be used for this part of the process—an awl, cut off and rounded, will do. The depressions in the reverse surface are then filled with some suitable substance to make the raised parts permanent. Sealing wax, or indeed wax of any type, may be employed as a filler. The main thing is that it shall completely fill the details of the depressed parts of the pattern, and solidify afterward in a form not easily disturbed. No filler should be used which is not immune to insect attack.

In plastic modeling the working surface is coated with a layer of some pasty substance to the thickness of about ¼ inch. There are available special manufactured coatings for this purpose, and any of several art modeling compounds will serve. These also can be obtained from art shops or stationery stores. The leather is treated as in flat modeling, the background being pressed down to force the plastic base into the elevations. In this process, it is necessary to work from the center toward the margins of the design, to prevent an excess of plastic material piling up around the central part of the surface as the work progresses.

In incised or cut-work, the design is traced in the usual manner, and then is retraced with a knife, so that a smooth cut is made through the surface layer of the leather. On one side of the cut the background is then pressed down, leaving the surface on the other side in clear relief. Some of the most beautiful work is done by this method.

Carved leatherwork calls for slits to be made beneath the parts of the design which the craftsman wishes to elevate. The slits should extend beneath only the outer surface of the leather. A sharp, fine-pointed knife may be employed for this purpose, or a lancet of the surgical type may be utilized. The slitting must be carefully done, to avoid injuring the surface appearance of the leather. Beneath each detail thus partially detached, a filling of cotton is inserted. Then the loose edge of the raised detail is gummed and pressed firmly back into place, leaving the detail in permanent relief.

A draftsman's compass, ruler, triangle, T-square, and other equipment of the same type will prove useful to the amateur in working out his design.

Facts That Amaze

(*Continued from page* 1006)

are listening to a sound that is so faint as to be just audible the molecules of the air are moving not more than three one-hundred-millionths of an inch from their normal positions. Yet they are beating upon your ear drums hard enough to make you hear the sound. A ray of light is indeed very short. Sometimes we consider it to be the shortest thing imaginable. The wave length of red light is about 0.000,03 inch. But the motion of the molecules in a very faint sound may be a thousand times shorter!

One of the strangest of all paradoxes is that a laborer does not work while unloading a truck. Our common notion of work is the expenditure of muscular effort. According to this notion one would be doing work if he merely supported a heavy load, such as a box, though obviously he would be doing no more than the ground upon which he lays his burden. Similarly, if he lowers the box to the ground we usually say that he is working though we would not admit that a plank down which a load skids is laboring also. Yet both the plank and the man accomplish the same result.

The only way out of this dilemma is to admit that the common idea of work is inconsistent and therefore erroneous. The scientist has a better definition of this term. He says "Work is the overcoming of resistance and is measured by the product of the force applied and the displacement produced by or against this force in the direction of the force." Now the force that the man applies to a box is upward whereas the displacement (i.e. movement) of the box is downward. Hence from the definition it appears that, the force of gravity is doing work on the box and on the man not the man doing work on the box.

To the average individual this argument will seem quite academical and the worker will rightly insist on being paid just as much for unloading the truck as for loading it, but the distinction between the common notion of work and the scientific definition is really highly important in the business of the scientist and engineer.

A person weighs more as he descends a mine because the outer layer of earth through which he is descending has only half the density of the core which he is approaching. The earth that lies above him, as he descends, tends, of course, to reduce his weight, but this affect is more than compensated by his approach toward the denser core beneath him. If a mine were deep enough he could reach a point beyond which his weight would decrease with further descent. By the time he reached the center of the earth the pull of gravity would be equal in all directions and then his weight would be zero.

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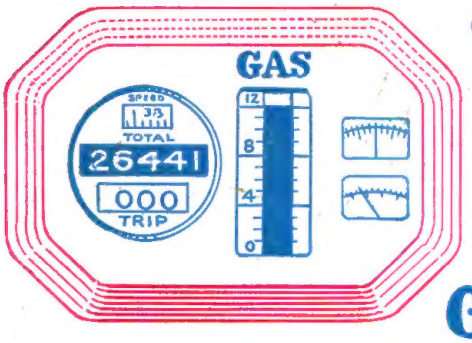
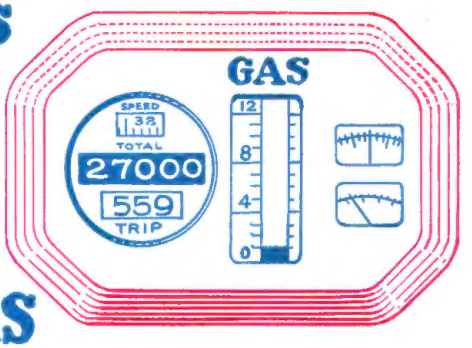


559 Miles on 11 Gallons of GAS



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Whirlwind users, reporting the results of their tests, are amazed at the results they are getting. Letters keep streaming into the office telling of mileages all the way from 22 to 59 miles on a gallon, resulting in a saving of from 25 to 50% in gas bills alone.

Mark H. Estes writes: "I was making 17 miles to the gallon on my Pontiac Coupe. Today, with the Whirlwind, I am making 35 5/10 miles to the gallon. Am I glad I put it on? I'll say so!"

P. P. Goerzen writes: "I made an actual test both with and without a Whirlwind, getting 13½ miles without and 34 6/10 miles with the Whirlwind, or a gain of 21 miles to the gallon. The longer the Whirlwind is in use on the machine, the better the engine runs, has more pep and quicker starting. It makes a new engine out of an old one, and starts at the touch of the starter button."

R. J. Tulp: "The Whirlwind increased the mileage on our Ford truck from 12 to 26 miles to gallon and 25% in speed. We placed another on a Willy's Knight, and increased from 12 to 17 miles per gallon.

Arthur Grant: "I have an Oakland touring car that has been giving me 15 miles to the gallon average, but I can see a great difference with the Whirlwind, as it climbs the big hills on high and gives me better than 23 miles to the gallon of gas, which is better than 50% saving in gas."

W. A. Scott: "I had my Whirlwind for three years. Winter and summer it gives the same perfect service, instant starting, smoother running, and what I saved in gasoline these last few years has brought other luxuries which I could not have afforded previously."

Car owners all over the world are saving money every day with the Whirlwind, besides having better operating motors. Think what this means on your own car. Figure up your savings—enough for a radio—a bank account—added pleasures. Why let the Oil Companies profit by your waste. Find out about this amazing little device that will pay for itself every few weeks in gas saving alone.

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